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MISSILE ACQUISITION STUDY, (U)
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UNCLASSIFIED LMI-NA801

MDA903-77-C-0370

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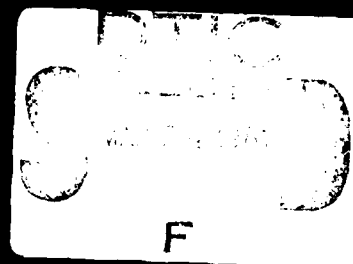
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MISSILE ACQUISITION STUDY.
FINAL REPORT

August 1979

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Thomas M. O'Hern, Jr.

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EXECUTIVE SUMMARY

STUDY OBJECTIVE

One of the major responsibilities of the Naval Air Systems Command (NAVAIR) is to manage the acquisition of all air-launched missiles for the Navy and for the Air Force when the Navy acts as the executive agent for joint-Service programs. NAVAIR currently has six missile programs: HARM, HARPOON, PHOENIX, SHRIKE, SIDEWINDER, and SPARROW.

Over the past several years, NAVAIR has experienced a continuing reduction in personnel, while both the complexity and number of weapon systems acquired have been increasing. The result is that NAVAIR has been unable to supply air-launched missiles to the fleet and the Air Force on schedule. In an effort to alleviate this problem, LMI was commissioned to (1) assess the feasibility and desirability of acquiring air-launched missiles from contractors in a ready-for-use configuration (known as the All-Up-Round (AUR) configuration) and (2) construct a Government-furnished equipment versus Contractor-furnished equipment (GFE/CFE) decision tree to assist acquisition personnel in making sound business judgments regarding the use of GFE and CFE in individual missile acquisition programs.

CONTRACTOR ASSEMBLY OF MISSILES

NAVAIR currently acquires missiles in two ways: (1) procuring all components and providing them to naval weapons stations for assembly into complete missiles (e.g., SHIRKE, SIDEWINDER, and SPARROW), or (2) procuring complete missiles from industrial concerns in the AUR configuration (e.g., HARPOON and PHOENIX). Regardless of the procurement method, a contractor may be responsible for the integration of GFE.

LMI found that contractor assembly of missiles is feasible, because a significant number of prime contractors possess the necessary technical qualifications and either possess, or have access to, suitable facilities. Making contractors responsible for missile integration will neither significantly lessen the capability of naval weapons stations to provide intermediate-level maintenance for the fleet's inventory of air-launched missiles, nor result in displacement of Federal employees.

Contractor assembly of missiles is also desirable for the following reasons: (1) it is consistent with national policy as expressed in OMB Circular A-76 and DoD's implementing instructions; (2) it would assign system responsibility to a single contractor, thus avoiding the fragmentation of organizational responsibilities which occurs when weapons stations assemble the missile; (3) it could result in a cost savings; (4) it would avoid having a large Government investment tied up in assets which are unusable due to missing components; and, (5) it would alleviate the problems associated with NAVAIR's current personnel shortage and enable acquisition personnel (now engaged in attempting to manage numerous small parts of missile programs) to manage their programs more effectively.

LMI therefore recommends that NAVAIR acquire air-launched missiles from prime contractors in the AUR configuration.

GFE/CFE DECISION TREE

In deciding whether selected components of a missile should be acquired as either GFE or CFE, a project manager should assess the technical, operational, logistic, and administrative factors, the potential risk of product degradation, and the potential cost savings. Present policy guidance concerning these decisions is incomplete. To meet NAVAIR's need for a comprehensive analytical guide to help its personnel make sound business and technical judgments regarding the GFE/CFE composition of its missiles, LMI constructed a GFE/CFE decision tree.

Certain aspects of NAVAIR's missile acquisition programs influenced the construction of the decision tree. First, every component of a NAVAIR missile is equally crucial. If the component is not available, the missile cannot be assembled. A missing component of an aircraft, ship, or tank may reduce the utility of the weapon, but for a NAVAIR missile, a missing component renders it inoperable. Second, standardization of major components of missiles does not now occur, and is not considered feasible because of the dissimilarity of the various missiles. Finally, since NAVAIR is faced with a serious shortage of personnel to manage its missile acquisition programs, the adequacy of in-house resources must be taken into account.

The decision tree is composed of three segments, one for each type of decision faced by a project manager: (1) those made in the initial acquisition of a system (i.e., the components have never been purchased before); (2) GFE to CFE conversions (break-in); or (3) CFE to GFE conversions (break-out). Guidelines for its use are also provided.

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1. INTRODUCTION

STUDY OBJECTIVES

One of the major responsibilities of the Naval Air Systems Command (NAVAIR) is to manage the acquisition of all air-launched missiles for the Navy. This responsibility also includes acquiring missiles for the Air Force when the Navy is the executive agent for joint-service programs, and for foreign governments as part of foreign military sales (FMS) programs. NAVAIR currently has five missile programs in the production stage: HARPOON (AGM/RGM-84), PHOENIX (AIM-54), SHRIKE (AGM-45), SIDEWINDER (AIM-9), and SPARROW (AIM-7). A sixth, HARM (AGM-88), is currently in the development stage.

Over the past several years, NAVAIR has experienced a continuing reduction in personnel, while both the complexity and number of weapon systems acquired have been increasing. The result is that NAVIAR has been unable to supply air-launched missiles to the fleet and the Air Force on schedule. NAVAIR perceived that two problem areas contributed to this undesirable situation. The first problem area involves missile assembly while the second involves Government-furnished equipment (GFE) versus Contractor-furnished equipment (CFE) decisions. LMI was commissioned by NAVAIR to analyze these two areas. The specific study objectives were to (1) assess the feasibility and desirability of acquiring NAVAIR missiles from contractors in a ready-for-use configuration (known as the All-Up-Round (AUR) configuration) and (2) construct a GFE/CFE decision tree to assist acquisition personnel in making sound business judgments regarding the use of GFE and CFE in individual missile acquisition programs.

DATA SOURCES

The data presented in this report have been collected from a variety of sources. Regulatory materials, such as the Defense Acquisition Regulation (DAR), Office of Management and Budget (OMB) Circulars, DoD Directives and Navy regulations, were reviewed to determine formal policy guidance. Procurement Plans (PPs) for selected Navy, Air Force, and Army missile programs were examined to establish the method of procurement and to extract historical data for each missile. A variety of other documents, such as contracts, annual appropriation and authorization acts, and intermediate maintenance instruction manuals, were also consulted.

The major data source was interviews with key missile acquisition personnel both inside and outside of NAVAIR. The project manager, contract negotiator, class desk officer and production specialist for each NAVAIR missile were interviewed, as well as individuals in NAVAIR 01 (Plans and Programs), 02 (Contracts), 04 (Logistics), 05 (Material Acquisition), 08 (Comptroller) and the Naval Weapons Engineering Activity (WESA). Weapons stations management data were obtained from cognizant Naval Sea Systems Command (NAVSEA) personnel and from a visit to Naval Weapon Systems (NWS), Yorktown. Data on other major weapons systems were obtained from cognizant procurement and technical personnel in NAVAIR, the Naval Material Command (NAVMAT), NAVSEA, the Air Force Systems Command (AFSC), and the Army Missile Command (MICOM).

DEFINITIONS

During the course of the study, it became evident that the terms GFE, CFE and AUR are subject to various interpretations. Further confusion also results from the fact that in practice a GFE item may be a component of another component. That is, the "end

item" is not always the missile. To avoid ambiguity, the following definitions were adopted for use throughout the study:

All-Up-Round (AUR) - A complete missile ready for fleet use. Assembly of missile components into the AUR configuration is accomplished by either a qualified contractor or a naval weapons station.

Contractor Furnished Equipment (CFE) - Items acquired or manufactured by a contractor to be incorporated into, or consumed in the production of, the product to be delivered under the contract.

Government Furnished Equipment (GFE) - Items in the possession of, or acquired by the Government and subsequently provided to a contractor to be incorporated into, or consumed in the production of, the product to be delivered under the contract.

Component - Subsystem, assembly, subassembly or other major element of an end item which could be contracted for separately and provided to an end item contractor as GFE.

End Item - A product which is contracted for separately and is in the form of either (1) a complete missile or (2) a component (i.e., any product which is a "deliverable" under a contract).

2. COMPLEXITIES OF THE MISSILE ACQUISITION PROCESS

Prior to discussing the feasibility and desirability of contractors assembling missiles in the AUR configuration (Chapter 3) and the development of a GFC/CFE decision tree (Chapter 4), this chapter addresses three complexities involved in managing missile programs - disparate acquisition processes, lead time coordination and fragmentation of missile management responsibilities.

DISPARATE ACQUISITION PROCESSES

NAVAIR currently acquires missiles in two ways: (1) Procuring all components and providing them to naval weapons stations for assembly into complete missiles (e.g., SHRIKE, SIDEWINDER, and SPARROW) or (2) procuring complete missiles from industrial concerns in the AUR configuration (e.g., HARPOON and PHOENIX). Regardless of the procurement method, a contractor may be responsible for the integration of GFE.

A detailed analysis of the specific acquisition process for each of the five NAVAIR missile programs is presented in Appendix A.

Figures 1 through 4 illustrate the flow of paperwork and hardware involved in acquiring major components of air-launched missiles. These figures are not intended to show the intricacies of each acquisition, but rather to illustrate that there is little consistency among the programs in the way components are acquired and assembled into missiles. Note that each dashed line may represent more than one procurement action.

Using the SPARROW program as an example, Figure 5 reveals the acquisition complexities associated with a missile program. It illustrates that the acquisition process is a great deal more complicated than the simplistic comparisons exhibited in Figures 1 through 4.

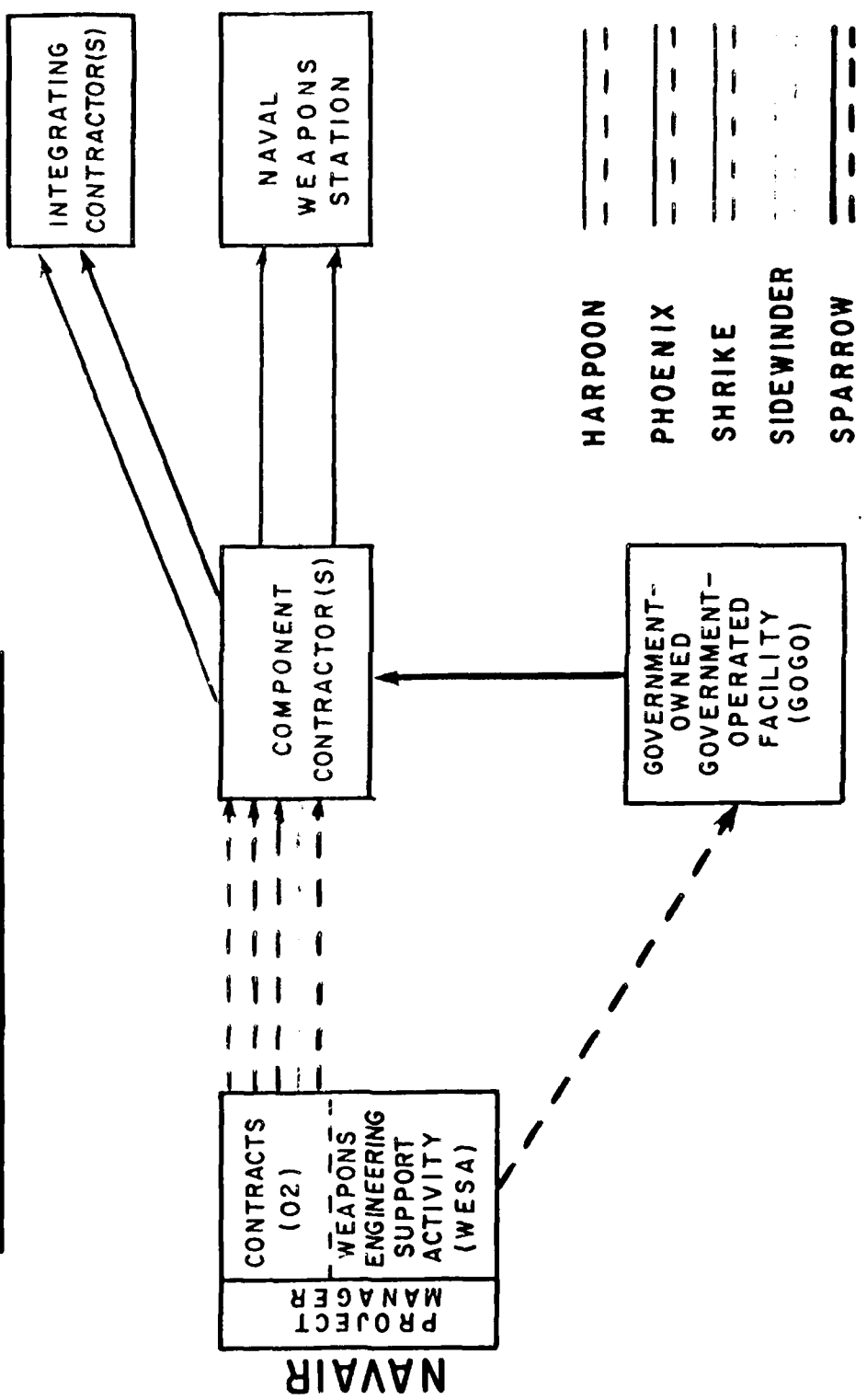
FIGURE 1



FIGURE 2

CURRENT NAVAIR MISSILE ACQUISITION PROCESS-

PROPULSION SECTION



SOLID LINE REPRESENTS PAPERWORK FLOW
 DASHED LINE REPRESENTS HARDWARE FLOW

FIGURE 3 CURRENT NAVAIR MISSILE ACQUISITION PROCESS -

WARHEAD SECTION

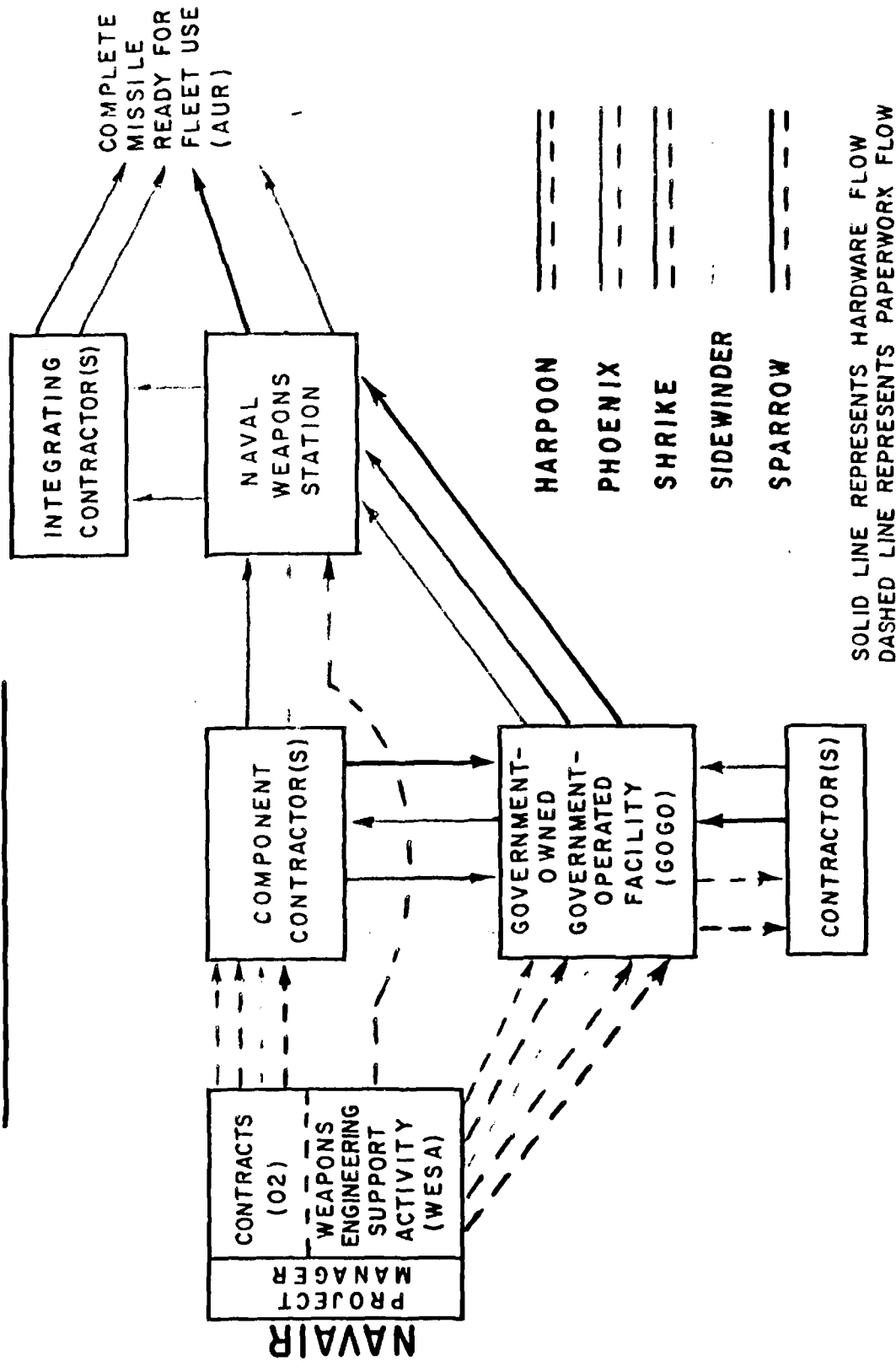
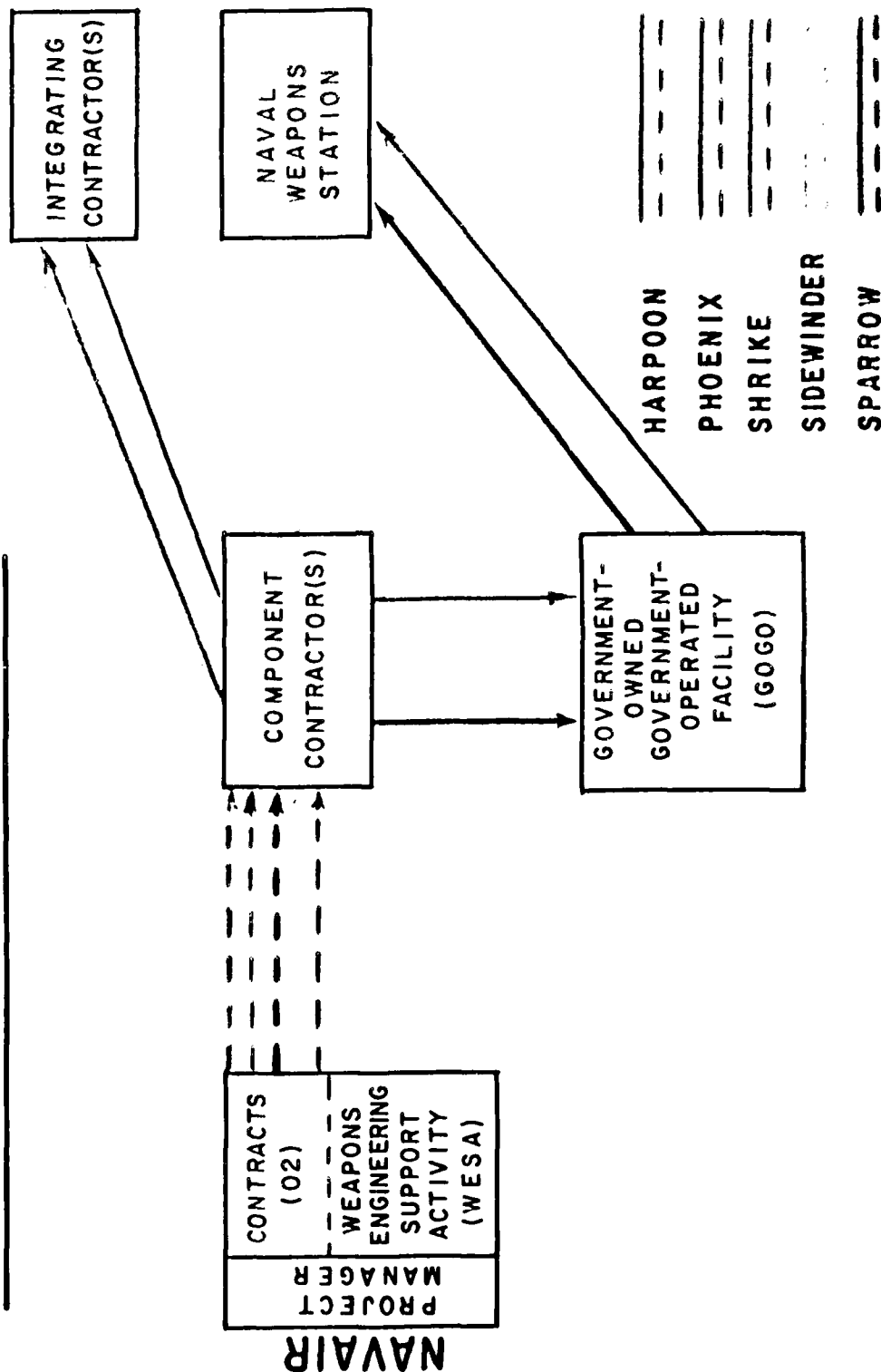


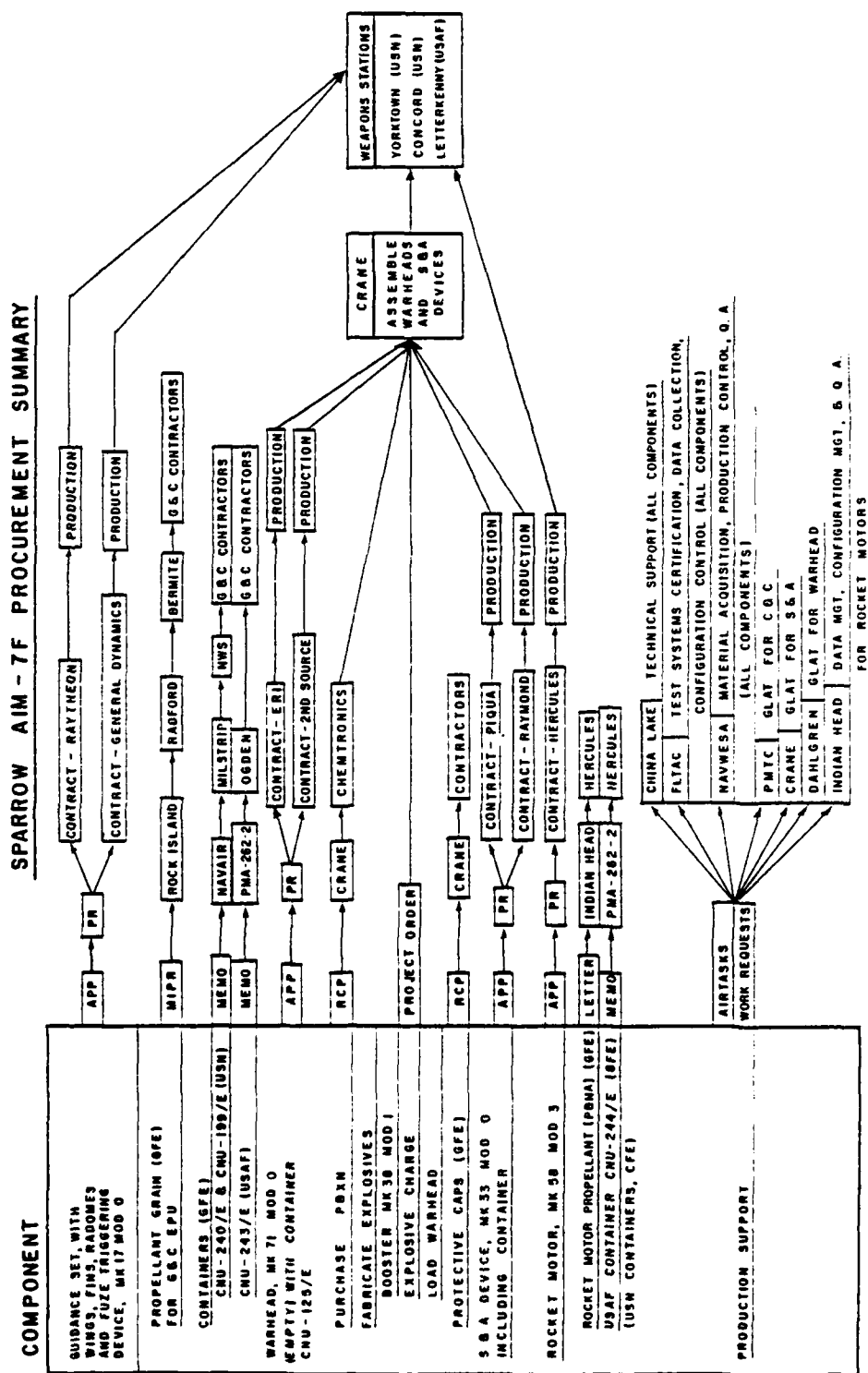
FIGURE 4

CURRENT NAVAIR MISSILE ACQUISITION PROCESS- SAFETY AND ARMING DEVICE



SOLID LINE REPRESENTS HARDWARE FLOW
DASHED LINE REPRESENTS PAPERWORK FLOW

FIGURE 5



COORDINATION OF LEAD TIMES

A major factor of the missile acquisition process which affects missile schedules is lead time complexities. The administrative and manufacturing lead times plus the delivery cycle are such that three, four, or even five year increments must be managed at any one time.

Administrative lead time for air-launched missiles (from Congressional approval to contract award) is approximately nine months in NAVAIR. Manufacturing lead times (from contract award to first delivery) range from 17 to 22 months. This means that before one year's deliveries begin, two successive years' requirements must be defined and started through the acquisition cycle. Before the first year's deliveries are completed, the program manager will be attempting to manage:

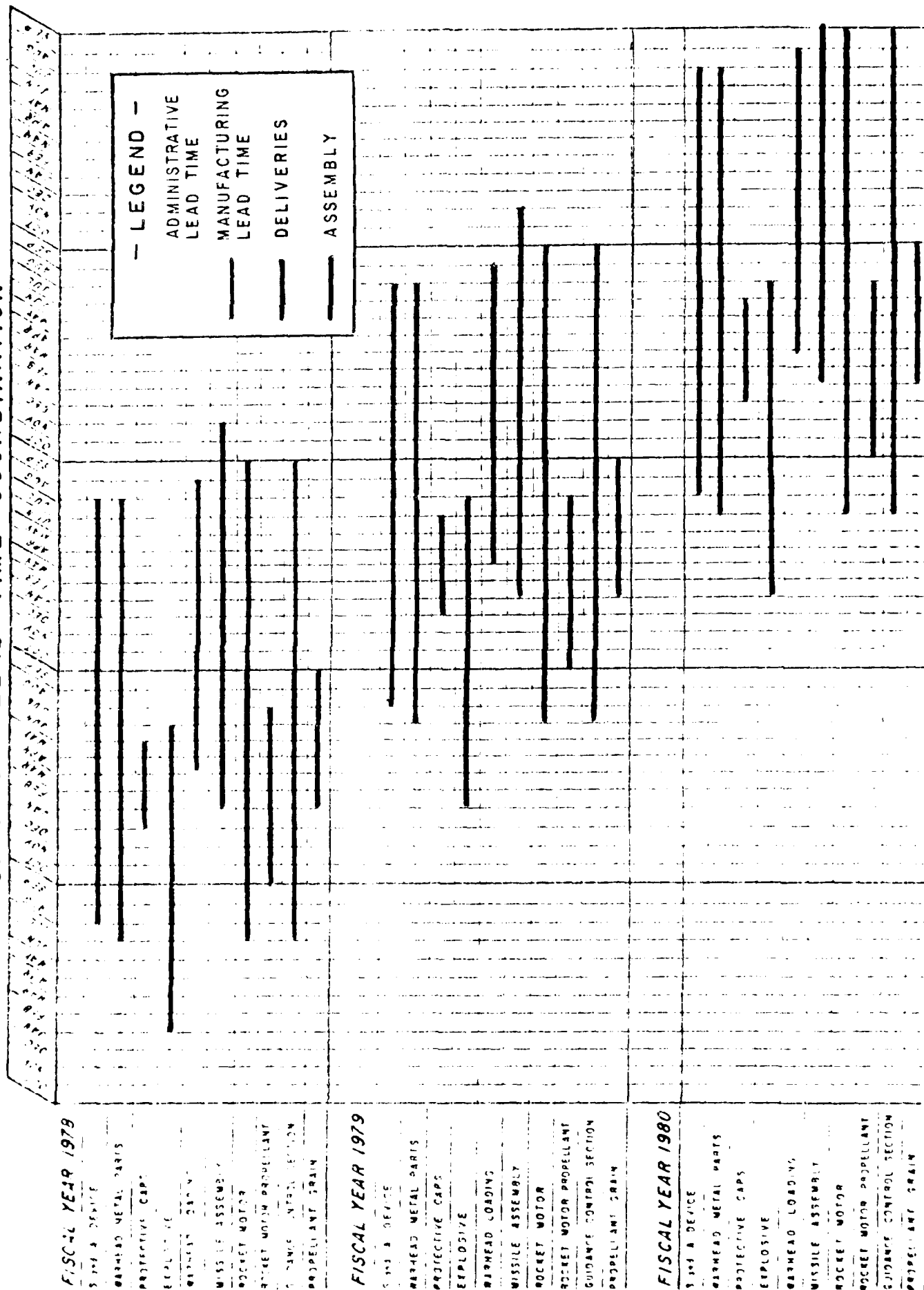
- the first year's manufacturing and assembly processes
- the second and third years' preparation for manufacture
- The fourth year's requirement definition, funding and pre-contract processes

Figure 6 depicts the complex coordination of lead times required for the SPARROW program.

In addition, lead times for subcomponents must be coordinated with those for components, since component manufacturers depend upon the timely delivery of subcomponents and subassemblies. For example, in the SPARROW program, the safety and arming device (S&A), warhead metal parts, protective, caps and explosives must all be available at Naval Weapons Support Center (NWSC) Crane before the warhead can be loaded. One ingredient of the rocket motor propellant must be delivered to the motor manufacturer and the propellant grain provided to the guidance and control (G&C) manufacturer before these major components can be delivered to the weapon station for missile assembly.

SPARROW LEAD TIME COORDINATION

FIGURE - 6



Coordination of lead times is further complicated if there is more than one source for an item. In addition, when contract awards are delayed, or slippages occur in either delivery schedules or weapons station assembly schedules, the need for management attention is increased.

FRAGMENTATION OF RESPONSIBILITIES

NAVAIR's missile acquisition programs can best be described as "fragmented". In the administrative area, the matrix form of project management is utilized. The project manager must rely on functional organizations to implement assigned responsibilities. LMI found that functional loyalties frequently impinge on program objectives. Attempts to increase competition and small business participation tax management control, increase the engineering and production liaison requirements, and frequently cause extensive delays in delivery of missile components.

Project management is further fragmented by the large number of naval activities involved in accomplishment of program objectives (see Figure 7). The contracting responsibilities for various missile components are performed by at least four different naval activities. Another complicating factor is that although NAVAIR provides overall management for the missile programs, it does not have management control over all participating organizations (e.g., NWC China Lake is a NAVMAT organization and the weapons stations are NAVSEA organizations).

Missile acquisition is further fragmented in those programs where the components are procured separately and then assembled by a weapons station. This fragmentation negatively affects NAVAIR's management efforts as well as contractors' responsibility for system performance.

FIGURE 7

NAVY FIELD ACTIVITIES PROVIDING PRODUCTION
SUPPORT TO NAVAIR MISSILE PROGRAMS

FIELD ACTIVITY			MISSILE PROGRAM				
			HARPOON*	PHOENIX	SHRIKE	SIDEWINDER	SPARROW
NWC	China Lake	(CA)	X	X	X	X	X
NWS	Concord	(CA)	X		X		X
FLTAC	Corona	(CA)	X	X		X	X
NWSC	Crane	(IN)	X	X	X	X	X
NSWC	Dahlgren	(VA)		X	X		X
NWS	Earle	(NJ)	X	X			
NWS	Fallbrook	(CA)			X		
NOS	Indian Head	(MD)	X	X	X	X	X
NADC	Johnsville	(PA)		X			
NOS	Louisville	(KY)	X				
NAS	Patuxent River	(MD)	X				
PMTC	Point Mugu	(CA)	X	X	X	X	X
SWSES	Port Hueneme	(CA)	X				
NAVWESA	Washington, D. C.		X	X	X	X	X
NSWC	White Oak	(MD)	X				
NWS	Yorktown	(VA)		X	X	X	X

*In addition, 11 other Naval field activities provide production support to the HARPOON program under air tasks in work requests issued by NAVWESA.

The fragmentations described above causes organizational tensions, which are exacerbated by two factors. First, current manpower levels in NAVAIR are insufficient to effectively manage the fragmented missile acquisition process. Second, there is no centralized organizational responsibility for missile acquisition policy and procedures. In addition, there are no uniform procedures for missile acquisition and no means of exchanging information between programs on procedures, contractors, etc.

In summary, NAVAIR's current missile acquisition management problems can be attributed to the nature of the weapons systems themselves, the number of components involved, the large number of participating organizations, NAVAIR's organizational structure, lead time complexities, and the lack of uniform policy and procedures.

3. CONTRACTOR ASSEMBLY OF MISSILES

As pointed out in the previous chapter, a major problem encountered in programs where missiles are assembled at weapons stations is the ensuing division of acquisition responsibility. In several instances, late deliveries of missile components have meant that fleet missile assets had to be "juggled" between ships. Late deliveries have also engendered much criticism of NAVAIR's operations by dissatisfied Air Force customers.

This chapter addresses both the desirability and the feasibility of having contractors assemble and test air-launched missiles in order to determine whether contractor assembly of all NAVAIR missiles would improve the acquisition process. The discussion is confined to work conducted by a missile integrator; i.e., the organizational entity which assembles missiles into the AUR configuration. Furthermore, we are concerned only with the initial assembly and testing of missiles and not with fleet returns (i.e., missiles returned from the fleet for periodic maintenance).

NAVAIR's basic responsibility in support of Navy mission objectives is to deliver quality weapons to the fleet in a timely manner at a reasonable cost. The ultimate objective of missile acquisition managers is to provide missiles to the fleet within these parameters. The importance of this objective must be remembered when analyzing the factors which influence the decision as to which organization should assemble the missiles.

During the course of the study, we identified seven factors which significantly affect a decision as to who should assemble air-launched missiles. These factors are (1) current policy guidance, (2) system integration responsibility, (3) technical capability, (4) facilities and test equipment, (5) military essentiality, (6) federal employee displacement, and (7) cost. A discussion of these factors and their impact on the assembly decision follows.

CURRENT POLICY GUIDANCE

Our review indicates that there is a lack of definitive NAVAIR policy guidance in NAVAIR regarding the use of private contractors or Government installations for assembling missiles. The limited guidance that does exist may actually conflict with national policy as expressed in the Office of Management and Budget (OMB) Circular A-76.

OMB Circular A-76 establishes a national policy of reliance on the private sector to supply the Government's needs for commercial or industrial products and services. This policy and the DoD's implementing instructions apply to the assembly of missiles, since this function constitutes a commercial or industrial activity as defined in A-76. Under the provisions of A-76 the only justifications for weapons station assembly of missiles would be: (1) the unavailability of a satisfactory commercial source (2) national defense requirements, or (3) significantly higher cost of a private commercial source. If justification is lacking, A-76 requires the work to be contracted out to private industry.

A-76 requires periodic (triennial) justification of all ongoing commercial/industrial activities. For current NAVAIR missile programs, this justification must be provided by NAVSEA, which has management control of the weapons stations. However, for a new program, a decision by NAVAIR to have weapons stations assemble the missiles would constitute a "new start," as defined in A-76. This would mean that NAVAIR would be required to demonstrate that its decision was consistent with the requirements of A-76.

In 1968 NAVAIR attempted to institute a policy of procuring missiles from contractors in the ready-for-issue (or AUR) configuration. Objections to this policy by the Commander of the Naval Ordnance Systems Command escalated to the Chief of Naval Material (CNM) level, who issued a letter to NAVAIR dated 4 August 1969, stating that there would not be a fixed policy regarding missile assembly. The only requirement placed on NAVAIR by CNM was that each missile procurement plan should document the basis for the particular assembly mode selected. Since then neither CNM nor NAVAIR has

issued any further guidance. NAVAIR's acquisition managers have been left to devise acquisition plans in a highly complex environment essentially on their own.

SYSTEM INTEGRATION RESPONSIBILITY

All of the NAVAIR missiles are highly complex, unmanned, one-way air vehicles with unit costs ranging from \$30,000 for SIDEWINDER to over \$500,000 for HARPOON. Since there is no opportunity to recover a missile after it is launched, NAVAIR requires a very high degree of reliability that the weapon system will perform when needed. The role of a system integrator is to combine the products of the various component manufacturers into a reliable weapon system.

In its contracts for the PHOENIX and HARPOON missiles NAVAIR has assigned system integration responsibility to contractors. However, the responsibility of these contractors is limited with respect to GFE. The Government is responsible for the functioning of the GFE, while the integrator is responsible for its interface with the rest of the weapon.

The integration of SIDEWINDER, SPARROW, and SHRIKE missiles is performed by naval weapons stations. However, there is no formal assignment of integration responsibility to the weapons stations and no guarantee of system accuracy or performance. The actual assembly work is subject to delay whenever the weapon station resources are required for fleet support activities.

The assembly of missiles at weapon stations presents other serious disadvantages besides the absence of assigned responsibility. NAVAIR incurs the costs of acceptance testing of components at contractors' plants as well as retesting the components at the weapons station prior to assembly. NAVAIR must position adequate quantities of missile components at the weapons stations to ensure that an assembly line remains open.

A different problem has been encountered in the SPARROW, SIDEWINDER and SHRIKE programs where occasionally all components but one (usually a low-cost item) have been delivered to the weapons stations in great quantities. The missing component

delays assembly of large numbers of complete missiles. The component shortages are caused by a variety of reasons which are not directly related to the missile assembly mode (e.g., production or quality control problems). Interviews with project managers revealed that, already short of personnel, the project managers are so busy managing engineering change proposals, data package deficiencies, second-sources and production problems at many contractors' plants that they lack the resources to manage the assembly function. Furthermore, the tendency of the weapons stations to view new missile assembly as "fill-in" work between peaks of fleet missile service requirements, combined with the lack of a firm commitment to assemble missiles in accordance with a specific schedule, results in insufficient attention to the accumulation of unassembled missile components at the weapon stations.

There are several advantages to having a prime contractor act as the system integrator, among which are greater opportunities to use contractual warranties and incentives. For instance the prime contractor AUR approach has a positive impact on the use of contractual commitments such as reliability improvement warranties (RIWs) and logistic support cost commitments (LSCCs).

Under RIW provisions, a contractor agrees to continue improving the reliability of an item while reducing its repair costs. The contractor further agrees to repair or replace all items that fail within a specified time. A RIW could not be obtained on a complete missile assembled at a weapons station since the weapons station is not a manufacturer or a contractor. Thus, only the components' manufacturers would be able to provide such warranty for their products. When missiles are procured from contractors in the AUR configuration, the presence of other factors such as the extent and nature of GFE (for which the system contractor would not be responsible), the inability to control unauthorized maintenance, and the inability to predict use environments and operational reliability may limit the usefulness of a RIW.

LSCC is an attempt to apply design-to-cost concepts to the operating and support costs of a weapon system. Under LSCCs, contractors are given operating and support cost

goals so that appropriate trade-offs may be made in the design phase to balance these costs with performance requirements. It would not be feasible to provide LSCCs in contracts for the components of end items since the components are not operated independently. The prime contractor AUR approach offers opportunities for applying this concept to missile acquisitions.

The use of the prime contractor AUR mode enhances other contractual commitments and pricing techniques as well. Item warranties, which might be vitiated when components are assembled by third parties, would be more enforceable. Life cycle costing can be applied in system procurements much more effectively than in a series of component contracts. While design-to-cost can be applied to components, the interfaces between components will receive more appropriate attention in a system procurement contract.

Another advantage to NAVAIR resulting from the assignment of integrating responsibilities to contractors is that the contractor has a clearly defined interest in the timely delivery of conforming missiles since his payment is contingent on such deliveries. If shortages of GFE occur, the integrator will be able to seek compensation from the Government for any resulting disruption of his delivery schedule. However, failure to solve the GFE shortage promptly may well jeopardize the award of subsequent missile system contracts. Therefore, the system integrating contractor will be highly motivated to assist in solution of the GFE shortage as quickly as possible.

TECHNICAL CAPABILITY

NAVAIR's air-launched missiles are similar in that, at a minimum, each has a G&C subsystem (which constitutes the major portion of the missile cost), a warhead subsystem, a fuzing subsystem, and a propulsion subsystem. The term "assembly of a missile" refers to the mating of these major subsystems. In addition, a set of wings and fins normally is attached to the missile prior to issuance to the fleet.

A missile may be tested in one of two ways, depending upon its type. Each component may be tested separately and subsequently assembled into an AUR missile, or the missile may be assembled first and then tested in the AUR configuration. The testing of a missile primarily involves checking its electronic circuitry.

In general, assembly and test of initial production missiles requires neither complex procedures nor many man-hours. At the risk of over-simplification, the process consists of visually inspecting the components, bolting the components together, and testing the electronic circuitry (though not necessarily in that order). The approximate amount of time necessary for the assembly and test of each missile in production is as follows:

PHOENIX	12 man-hours
SHRIKE	14 man-hours.
SPARROW	22.4 man-hours.
SIDEWINDER	10.8 man-hours.
HARPOON	100 man-hours (not including launch kits).

At the assembly level, technical expertise is necessary in the areas of missile handling, integration, and testing. We reviewed Army and Air Force missile acquisition procedures and found that both services employ integrating contractors for all of their missile programs. Many contractors possess the necessary expertise. Figure 8 lists the current missile programs in which contractors integrate missiles into the AUR configuration for the other services. Four of the six G&C section contractors for NAVAIR are represented (Raytheon, Ford Aeronutronic, Hughes, and General Dynamics). Except for Hughes, none of these companies currently acts as integrators for NAVAIR. It is also relevant to note that Ford Aeronutronics integrates the SIDEWINDER AIM-9J, which the Air Force buys for FMS while NAVAIR requires the AIM-9L version to be integrated by naval weapon stations. Still, NAVAIR recognizes that contractors do have the capability to integrate missiles as evidenced by its current AUR contracts with McDonnell-Douglas and Hughes for the HARPOON and PHOENIX programs respectively, and has had earlier contracts with General Dynamics for the STANDARD ARM missile.

FIGURE 8. MISSILE INTEGRATION CONTRACTORS

<u>MISSILE</u>	<u>SERVICE</u>	<u>INTEGRATING CONTRACTOR</u>
CHAPARRAL	Army	Ford Aeronutronic
LANCE	Army	LTV
PATRIOT	Army	Raytheon
ROLAND	Army	Hughes/Boeing
STINGER	Army	General Dynamics
DRAGON	Army	Raytheon
TOW	Army	Hughes
HELLFIRE	Army	Rockwell International
IMPROVED HAWK	Army	Raytheon
MAVERICK	Air Force	Hughes
SIDEWINDER (AIM-9J)	Air Force	Ford Aeronutronic

FACILITIES AND TEST EQUIPMENT

The handling of complete missiles requires unique facility safety considerations. For example, at NWS Yorktown there are limitations on the quantities of particular explosives which can be present in one structure at one time. Facilities for safe handling and storage of loaded warheads and rocket motors are mandatory at any location where completed missiles are to be assembled.

Figure 9 lists the private facilities at which missiles are currently being assembled.

FIGURE 9. MISSILES ASSEMBLED AT CONTRACTORS' FACILITIES

<u>MISSILE</u>	<u>INTEGRATING CONTRACTOR</u>	<u>ASSEMBLY POINTS</u>
CHAPARRAL	Ford Aeronutronic	Contractor's Plant
HARPOON	Hughes	Contractor's Plant
SIDEWINDER (AIM-9J)	Raytheon	Subcontractor's Plant
MAVERICK	Hughes/Boeing	Contractor's Plant
PATRIOT	General Dynamics	Contractor's Plant
PHOENIX	Rockwell International	Contractor's Plant
ROLAND	Hughes	Contractor's Plant
HELLFIRE	Ford Aeronutronic	Contractor's Plant
STINGER	Hughes	Contractor's Plant
TOW	McDonnell-Douglas	Contractor's Plant

Ford Aeronutronic, General Dynamics, Raytheon, and Texas Instruments currently supply G&C sections to weapons stations for assembly into complete air-launched missiles. Figure 8 shows that three of these four contractors either possess or have access to assembly facilities for other missile programs.

In addition to these private plants, some Government installations can be used as missile assembly points. For example, Raytheon assembles the HAWK and DRAGON missiles while LTV assembles the LANCE missile at Army arsenals.

The test equipment required to check out missiles after assembly does not appear to present any significant obstacle to either Government or contractor assembly of missiles. The nature of the components generally dictates the kinds of tests which can or must be made. For example, warheads can only be tested by exploding samples. Motors are generally test-fired, but the firing circuitry of some motors can be tested without actual firing. Most testing is done on the individual components. The HARPOON, PHOENIX, and SPARROW missiles are tested after final assembly, and the SIDEWINDER can be tested after assembly only when loaded on an aircraft. The post-assembly test of the SHRIKE consists of a check of the G&C section and the wings and fins. Appendix B details the test procedures for all major components of the five missiles currently being produced.

No accurate measurement of the amount or cost of test equipment which would be required for a conversion from Government to contractor assembly can be made without contractors' input in response to NAVAIR's requirements. However, this factor does not appear to present any significant barrier to such a change, and the cost input could be easily measured once a potential requirement is established.

MILITARY ESSENTIALITY

Another factor to be considered in the missile assembly decision is whether or not assembly of new production missiles by contractors would significantly diminish Navy in-house capability to assemble and test missiles.

Naval weapons stations perform intermediate-level maintenance on all air-launched missiles in the fleet inventory. This function includes handling, visual inspections, disassembly, test, minor repairs, replacement of damaged or defective components and reassembly of the missiles. In addition, every missile is scheduled for periodic testing by the weapons station every two years. No change in responsibility for this function is anticipated. Repair of major components will continue to be conducted by depot maintenance facilities or by contractors. Thus, the assembly of new production missiles by contractors would not diminish the intermediate maintenance capability of weapons stations.

Under its current mobilization preparedness programs, NAVAIR establishes contingency plans with the producers of all items needed at mobilization. This includes the assembly of missiles as well as component production. NAVAIR's industrial resources specialists advise that changes from Government to contractor assembly would not adversely affect their planning efforts.

FEDERAL EMPLOYEE DISPLACEMENT

Changes in the assembly point for missiles currently assembled by weapons stations, raise the possibility that Federal employees may be displaced. Assessment of this factor was extremely difficult because of the reluctance of NAVSEA personnel to provide data relating to staffing or workload of the weapons stations. The following data were gathered from interviews with operating personnel at NWS Yorktown:

- NWS Yorktown's missile assembly and test operations are currently at full capacity.
- There are 45 persons involved in missile assembly and test at Yorktown
- Approximately 15 percent of the Yorktown missile assembly and test operation is for NAVAIR's new production missiles
- NWS Yorktown usually completely assembles 50 percent of the SIDEWINDER, SPARROW, and SHRIKE new production missiles.

The intermediate maintenance function performed by the weapons stations appears to provide a major portion of their workload. Justification material for NAVAIR's FY80 budget submission indicates funding is required for intermediate maintenance of 4708 missiles at the weapons stations. This projected maintenance workload represents a 15 percent decrease from the estimated FY79 level. However at the present time, the fleet inventory of missiles is increasing. As component shortages for the SPARROW, SIDEWINDER and SHRIKE are overcome, and as the HARPOON is introduced to the fleet, inventory levels will rise significantly, thus increasing the future maintenance workload.

Thus, the reduction forecast for FY80 does not necessarily indicate a trend but it may merely reflect a temporary dip in workload. The current acquisition plan for the HARPOON missile alone will increase the maintenance workload by 120 missiles per year for the next eight or nine years. Thus, the possibility of any Federal employee displacement resulting from the assignment of the missile assembly function for current and future programs to private contractors appears minimal.

COST

Cost certainly is a factor which merits consideration when choosing between alternative modes of missile assembly. Nevertheless, care should be taken not to overemphasize its importance in the decision-making process. Costs do not exist in a vacuum. Other circumstances may sometimes dictate that nonmonetary considerations take precedence over, or at least temper, cost considerations. For example, a decision to choose an organization to assemble a missile solely on the basis of cost will not benefit the fleet if that organization fails to meet its delivery schedules. In short, while cost data are important, they should be placed in proper perspective in the overall acquisition picture.

In assessing the cost of assembling air-launched missiles, it is necessary to determine: (1) the cost to NAVAIR, (2) other Navy costs, and (3) other Government costs.

Cost to NAVAIR

The cost to NAVAIR for integration and test of missiles assembled by contractors is included in the contract price, although it may not be shown as a line item. In the case of weapons station-assembled missiles, NAVAIR issues cost-reimbursable project orders to the weapons station. Billings against completed project orders are not itemized. Since these billings often contain other unrelated charges (e.g. special testing or corrective work), would be unreliable in determining the actual cost of assembling and testing missiles.

Actual weapons station cost data were unavailable for use in this study due to NAVSEA's reluctance to provide such data. Instead, cost estimates provided by a weapon station were used. These estimates contained the type of labor, cost centers, number of man-hours required, wage rates, and any additional charges necessary to perform the work.

To provide a meaningful cost comparison between weapons station and contractor assembled missiles, the analysis focused on HARPOON since it is the only NAVAIR air-launched missile program in which the integration function has been conducted by both a weapons station and a contractor (McDonnell-Douglass). Although historical costs associated with the assembly and test of one missile program cannot be used to predict similar costs for another program, the basic analysis is equally applicable to all programs.

HARPOON missiles are built up from missile sections into a HARPOON missile body (HMB). These HMBs (also known as "slick" missiles) are then configured by a weapon station for either air-launch, surface ship-launch, or submarine-launch so that changing fleet needs can be met. The cost of assembling HARPOON missiles varies. Depending on which launch kit is attached, the number of man-hours required and hence the cost of assembly vary. However, the procedures involved in assembling HMBs, which for all practical purposes are complete missiles, remain the same no matter which configuration is employed.

The actual assembly of a HMB involves the mating of four sections: guidance, control, sustainer, and warhead (or an exercise section). However, the role of a HARPOON integrator also includes the assembly and test of the warhead section. Thus, warhead assembly costs should be added to the basic missile assembly costs in order to establish an accurate estimate of the total cost. Figure 10 presents FY78 cost estimates for the assembly and test of HMBs and is followed by an explanation of the elements comprising these estimates.

FIGURE 10

FY78 COST ESTIMATES FOR THE ASSEMBLY AND TEST OF HARPOON

	<u>USN</u>	NWS Concord (\$ per unit)	<u>FMS</u>	McDonnell-Douglas (\$ per unit) <u>USN</u>
HMB Assembly and Test	\$1,794.84		\$2,056.01	\$2,171.93
Warhead Assembly and Test	<u>\$1,153.75</u>		<u>\$1,045.37</u>	<u>\$ 850.03</u>
Total	\$2,948.59		\$3,101.38	\$3,021.96

Sources: FY78 cost estimates from NWS Concord and FY78 McDonnell-Douglas proposal to NAVAIR.

McDonnell-Douglas Cost Estimate. McDonnell-Douglas' figures include a 10.25 percent target profit, and the firm appears to be moving down its learning curve, since the contract price for the same work in FY77 was \$3,114, and the proposed price for FY79 is \$2,888.55. The FY78 and FY79 cost estimates should not be considered exact since its figures are negotiable.

McDonnell-Douglas' numbers in Figure 10 reflect direct labor for missile assembly only. The company may charge NAVAIR additional costs for technical support during the assembly process. However, assembly of the missile at the weapon station also

generates similar costs. For example, McDonnell-Douglas provides three people (and others when necessary) to Concord for technical support purposes. Based upon available information as to the relative costs of this support, a reasonable assumption can be made that the support costs associated with each mode of assembly offset each other.

NWS Concord Cost Estimate (USN). Concord is a Naval Industrial Funded (NIF) activity. This means that it uses stabilized (or predetermined) rates in billing its Federally sponsored customers, such as NAVAIR. While other customer sponsored work (such as FMS) is billed at actual costs.

Concord accepts all NAVAIR missile assembly orders on a cost reimbursable basis. The cost estimate is based upon published stabilized rates which are in effect during the entire fiscal year. Work performed on this basis is billed at stabilized rates regardless of Concord's actual cost to perform.

The stabilized labor rate includes the cost of direct labor, direct material, other charges reported as direct costs, and the composite overhead rate. At NIF activities, such as Concord, all civilian salaries and wages are accelerated (increased) by a predetermined rate to provide for accrued liabilities for annual leave, sick leave, holiday and other paid leave and the Government's contribution to the Federal Employees' Group Life Insurance Fund, Federal Insurance Contribution Act, Civil Service Retirement Fund, and Federal Employees' Health Benefits. The acceleration of labor for these accruals is accomplished by the application of a single composite percentage rate to amounts earned for all hours worked (not to gross payroll). Composite acceleration rates for NIF activities vary between 30 and 32 percent. Figure 11 presents a representative example of how an actual NIF activity computes its composite acceleration rate.

As will be shown later, these percentages, except for the retirement fund factor, closely parallel those prescribed by OMB Circular A-76.

FIGURE 11

COMPOSITION OF NIF ACTIVITY'S LABOR ACCELERATION RATE

<u>FRINGE BENEFITS</u>	<u>LABOR ACCELERATION RATE</u>
Annual Leave	11.8%
Sick Leave	5.1%
Holiday and Other Leave	4.1%
Federal Employees' Group Life Insurance	0.5%
Federal Employee's Health Benefits	2.8%
FICA Taxes	0.2%
Civil Service Retirement Fund	<u>7.3%</u>
	31.8%

The stabilized labor rate also includes an overhead factor. There are four types of overhead associated with NIF activities: funded production expense, unfunded production expense, funded general expense and unfunded general expense. Funded production expense and funded general expense overhead rates apply to Federally sponsored work. Funded production expenses are NIF-financed expenses incurred by direct cost centers, which are not identifiable to a specific direct job order. Funded general expenses are NIF-financed expenses incurred by general cost centers, which are not identifiable to a specific direct job order. The funded overhead (both production and general) is prorated to the missile assembly and test process by applying predetermined rates to the direct hours worked by civilian employees and military personnel.

Other Navy Costs

NIF activities are required to recover the full cost of all work performed for FMS customers. Figure 10 shows that estimates of actual cost are higher than those based on stabilized rates. Thus, a more accurate estimate of the costs to the Navy of assembling and testing missiles is reflected in the FMS figures.

The FMS cost estimate contains actual wage and overhead rates as well as a "statistical charge" which represents unfunded production and general expenses

(overhead). Unfunded production expense is the cost of the time worked by military personnel assigned to a productive cost center and not identifiable to a specific direct job order. Unfunded general expense is the cost of the time worked by military personnel assigned to the general cost centers and not identifiable to a specific direct job order. The statistical charge also takes into account depreciation of the buildings and equipment. (Note that the stabilized rates used on USN work do not include depreciation).

Figure 10 shows that NAVAIR is not paying the actual direct costs associated with the assembly and testing of HMBs. The "hidden" cost to the Navy is equal to the difference between the USN and FMS cost estimates (i.e., \$152.79 per missile). This means that the weapons station is recouping these "hidden" costs from other Navy appropriations (e.g., military construction).

Other Government Costs

There are some costs to the Government which do not appear when comparing weapons station and contractor cost estimates. These "hidden" expenses are incurred by the Government as a cost of doing business with the weapons stations. For example, there is a loss of Federal and state revenue, since weapons stations are exempt from taxation. However, if commercial enterprises perform the assembly and test function, they are at corporate rates.

Another hidden cost to the Government arises from late deliveries of components to a weapons station. The missile cannot be assembled until the late components arrive; meanwhile the already delivered components sit idle. This results in an opportunity cost to the Government, since an imputed charge can be made on its investment in those idle components. In other words, the Government pays interest on the money it borrows, but it does so expecting to provide missiles to the fleet. When the components are idle, this expectation is not met. Thus, for every day that components are unassembled, the Government is paying interest expenses but not receiving missiles.

Figure 12 illustrates the opportunity costs associated with delayed deliveries of components. For illustration purposes, the figure makes the following simplifying assumptions: (1) the other components were delivered in a timely fashion awaiting AUR build-up, (2) only one component was late, and 3) there were no partial deliveries of the late component.

The figure shows that for the SHRIKE program the electronic assembly (priced at \$265) creates a \$107 opportunity cost to the Government for every month that it is late. In the case of the SPARROW program, the S&A device (priced at \$773) creates a \$842 opportunity cost to the Government for every month that it is late.

Other hidden costs to the Government resulting from delayed deliveries are (1) the salaries of Government personnel required to assist the contractor in correcting his problems, and (2) increased contract administration and technical costs since the life of the contract is being extended.

Most of these hidden costs would not be incurred if a commercial enterprise assembled and tested the missiles. The contractor would be held to his contract price for performing the work. If he were responsible for the acquisition of a component, he would have to solve any late delivery problems at his cost. On the other hand, if a component is furnished to a contractor as GFE, NAVAIR may find itself liable to the integrating contractor for costs associated with schedule slippages. However, this disadvantage may, in turn, be offset by the fact that the integrating contractor would be monitoring all component delivery schedules. If a potential delivery problem arose, it would be to the contractor's benefit (as well as the Government's) to notify NAVAIR and possibly prod it into taking corrective action. (This management control benefit has been discussed previously under "System Integration Responsibility.")

FIGURE 12. OPPORTUNITY COSTS ASSOCIATED WITH LATE DELIVERIES

PROGRAM	LATE COMPONENT	HARDWARE COST PER MISSILE*	COST OF LATE COMPONENT*	DISCOUNT RATE**	MONTHS PER YEAR	LOST INTEREST PER MONTH	AVG. LOT SIZE*	INTEREST EXPENSE PER MONTH OF DELAY	NO. MONTHS COMPONENTS LATE*	TOTAL OPPORTUNITY COST
SHRIKE 3A (FY73)	Electronic Assembly	\$ 13,140 -	\$ 265	X 10%	÷ 12 =	\$ 107	X 50 =	\$ 5,350	X 43 =	\$ 230,050
SPARROW 7F (FY75)***	S&A Device	\$ 101,856 -	\$ 773	X 10%	÷ 12 =	\$ 842	X 25 =	\$ 21,050	X 33 =	\$ 694,650

* Data supplied by NAVAIR.

** The 10% factor is prescribed in the revised OMB Circular A-76 handbook.

*** Air Force buy.

Retirement funds represent another cost to the Government. As shown earlier, when computing labor acceleration rates, a NIF activity apportions approximately 7 percent to the Civil Service Retirement Fund. Revised OMB Circular A-76 prescribes using 20.4 percent when performing cost comparisons between in-house and commercial enterprises. This will result in a higher labor acceleration rate and, hence a higher stabilized rate will need to be used when performing cost comparisons. Figure 13 presents a comparison between the NIF labor acceleration rate elements and the factors prescribed by the revised OMB A-76.

FIGURE 13

COMPARISON BETWEEN NIF LABOR ACCELERATION RATE ELEMENTS
AND OMB CIRCULAR A-76

	<u>NIF LABOR ACCELERATION RATE</u>	<u>A-76 FACTOR</u>
Annual Leave	11.8%	20.0%
Sick Leave	5.1%	
Holiday and Other Leave	4.1%	
Federal Employees' Group Life Insurance	0.5%	4.0%
Federal Employees' Health Benefits	2.8%	
FICA Taxes	0.2%	Actual Employer Contribution (Assume 0.2%)
Civil Service Retirement Fund	<u>7.3%</u>	
		<u>20.4%</u>
TOTAL	31.8%	44.6%

In summary, the above cost analysis indicates that contractor assembly of missiles does not significantly increase costs to the Government. Indeed, it may result in a cost savings. When a missile is assembled at a weapons station, NAVAIR pays less than

the actual costs associated with such assembly. This fact is clearly shown when NAVAIR missile assembly costs (based on stabilized rates) are compared with FMS assembly cost (based on actual costs). This hidden cost to the Navy is recouped by the weapons station from other Navy appropriations. Other "hidden" expenses incurred by the Government as a cost of doing business with weapons stations include loss of tax revenue, extra Governmental contract administration and technical costs, actual retirement costs, and finally, the opportunity costs associated with late component deliveries.

CONCLUSIONS AND RECOMMENDATIONS

Contractor assembly of missiles is feasible because a significant number of prime contractors (in addition to the two NAVAIR contractors already performing this work) possess the necessary technical qualifications and either possess or have access to suitable facilities. Placing the responsibility for missile integration on contractors will neither significantly lessen the capability of naval weapons stations to provide intermediate-level maintenance for the fleet's inventory of air-launched missiles, nor is it likely to result in displacement of Federal employees.

Contractor assembly of missiles is also desirable for the following reasons: (1) it is consistent with national policy as expressed in OMB Circular A-76 and DoD's implementing instructions; (2) it would establish system responsibility in a single contractor, thus avoiding the fragmentation which occurs when weapons stations assemble the missile; (3) it could result in a cost savings; (4) it would avoid having a large investment in unusable assets which are unusable due to missing components; and, (5) it would alleviate the problems associated with NAVAIR's current personnel situation and enable acquisition personnel (now engaged in attempting to manage numerous small parts of missile programs) to manage their programs more effectively. Therefore, we recommend that NAVAIR acquire air-launched missiles from prime contractors in the AUR configuration.

To implement this recommendation, NAVAIR should:

1. Issue a policy instruction at the earliest possible date establishing contractor assembly as NAVAIR policy for all air-launched missiles.
2. Modify the HARM procurement plan so that the missiles can be acquired from prime contractors in the AUR configuration.
3. Convert the SIDEWINDER and SPARROW programs to contractor assembly prior to FY81. (Since these are ongoing programs, particular attention must be given to the adequacy of specific contractor's facilities and to program budget limitations).
4. Retain weapons station assembly for the SHRIKE program since all Navy requirements have been contracted for, with no further purchases expected after FY79.

4. GFE VERSUS CFE DECISIONS

DoD acquisition policies and procedures recognize that it may be beneficial for the Government, when contracting for weapon systems and other major items, to procure some components directly and provide them to the end item contractor as GFE.

Advantages which accrue to the Government when components are provided as GFE include:

- cost savings
- improved logistics support and economies in operations and training made possible by standard designs
- competitive procurement of high dollar value components of noncompetitive systems
- maintenance of a broad industrial base
- small and minority business participation in Government contracting
- direct control over critical components

The use of GFE, however, divides responsibility for the end item. The Government is responsible for the quality, reliability, performance, and timely delivery of the GFE, while the contractor is responsible for the CFE. Thus, use of GFE requires that the Government manage the acquisition of GFE components and assure its timely delivery to the end item contractor in addition to its regular overall management responsibilities.

Before deciding whether selected components of major systems should be acquired as either GFE or CFE, a project manager should assess the technical, operational, logistic, and administrative factors, the potential risk of product degradation, and the potential cost savings. Present policy guidance concerning these decisions is incomplete. To meet NAVAIR's need for a comprehensive analytical guide to help its personnel make sound

business and technical judgments regarding the GFE/CFE composition of its air-launched missile acquisition programs. LMI constructed the decision tree described in this chapter. It is intended for use in both the program initiation phase and during the remainder of the acquisition cycle to determine the desirability and timing of changes to a program's GFE/CFE structure.

The decision tree was evaluated in an operating environment by NAVAIR personnel representing functional areas (Project Management, Contracts, Class Desk, and Production) in each of the six NAVAIR missile programs. As a result of the evaluation, modifications to both the decision tree and the accompanying guidelines were made.

POLICY BASIS FOR GFE/CFE DECISIONS

The general policy of DoD, as stated in DAR 13-201, is that contractors will furnish all material required for performance of Government contracts; i.e., that all material will be CFE. DAR 13-201 also states that the Government should provide GFE to a contractor when it is in the best interest of the Government by reason of economy, standardization, the expediting of production, or other appropriate circumstances.

DoD policy guidance concerning the GFE/CFE decision process is set forth in DAR 1-326 "Component Breakout." It provides that components will be "broken out" of the end item procurement, i.e., purchased directly by the Government and provided as GFE, whenever:

- the weapon system or other major end item is purchased without adequate price competition
- the prime contractor is expected to acquire the component without adequate price competition
- substantial net cost savings will probably be achieved
- the quality, reliability, performance or timely delivery of the end item will not be jeopardized

The DAR policy also provides for consideration of break-out of components (regardless of whether or not they are being purchased competitively), if substantial net cost savings can be achieved from greater quantity purchases, improved logistics support, or economies in operations and training through standardization of design.

This DAR guidance applies only to conversions of components from CFE to GFE, i.e., break-out. It contains no guidance on conversions from GFE to CFE, i.e., break-in, nor does it contain any guidance for the initial GFE/CFE decisions that must be made at the inception of a program.

DAR 1-326 sets forth guidelines for assessing potential risks, calculating estimated savings, and analyzing the technical, operational, logistic and administrative factors involved in the GFE/CFE decision. However, it provides no guidance as to the relative importance of the various factors and no sequence for their consideration. Thus, acquisition personnel are required to make decisions based on their own perceptions of the degree and significance of the risks involved and the estimated cost savings.

The DAR guidance is supplemented by NAVAIR Instruction 4200.5A, 5 August 1969, entitled "Policy and Procedures Governing the Determination of GFE versus CFE in the Procurement of NAVAIR Material." This instruction provides that GFE will be the maximum amount permitted by technical and administrative in-house resources, consistent with NAVAIR's responsibility to deliver quality systems to the fleet. Primary break-out consideration is directed to components costing \$300,000 or more per annual buy.

The instruction establishes two categories of candidate components for GFE, one for the initial purchase, the other for conversion from CFE to GFE on subsequent purchases. No guidance is provided on conversion of GFE to CFE.

STRUCTURE & USE OF THE GFE/CFE DECISION TREE

The primary goal of the missile project manager is to acquire a quality system, in a timely manner and at a reasonable cost. All GFE/CFE decisions must be consistent with

this goal. The decision tree (Figure 14) was designed to facilitate consideration of all factors relevant to GFE/CFE decisions in an organized fashion, and to allow assessment of the relative importance of each factor.

Certain aspects of NAVAIR's missile acquisition programs influenced the construction of the decision tree. First, every component of a NAVAIR missile is equally crucial. If the component is not available, the missile cannot be assembled. A missing component of an aircraft, ship, or tank may reduce the utility of the weapon, but for a NAVAIR missile, a missing component renders it inoperable. Second, standardization of major components of missiles does not now occur, and is not considered feasible because of the dissimilarity of the various missiles. Finally, NAVAIR is faced with a serious shortage of personnel to manage its missile acquisition programs and thus the adequacy of in-house resources must be taken into account.

The project manager faces three basic types of GFE/CFE decisions: (1) those made in the initial acquisition of a system (i.e., the components have *never been purchased* before) (2) GFE to CFE conversions (break-in); or (3) CFE to GFE (break-out). The decision tree is composed of three segments, each of which corresponds to each type of decision.

The design of the decision tree requires "yes" or "no" responses to the questions. As a practical matter, responses will generally be in the form of "probably yes" or "probably no." This is due to the ambiguities of the data as well as the necessity to assign probabilities to the occurrence or nonoccurrence of future events. Nevertheless, these "probably yes" and "probably no" responses should be classified as "yes" or "no" responses, respectively.

Guidelines are provided in Figure 15 to assist acquisition personnel in the use of the decision tree.

FIGURE-14
GFE/CFE DECISION TREE
FOR MISSILE ACQUISITION

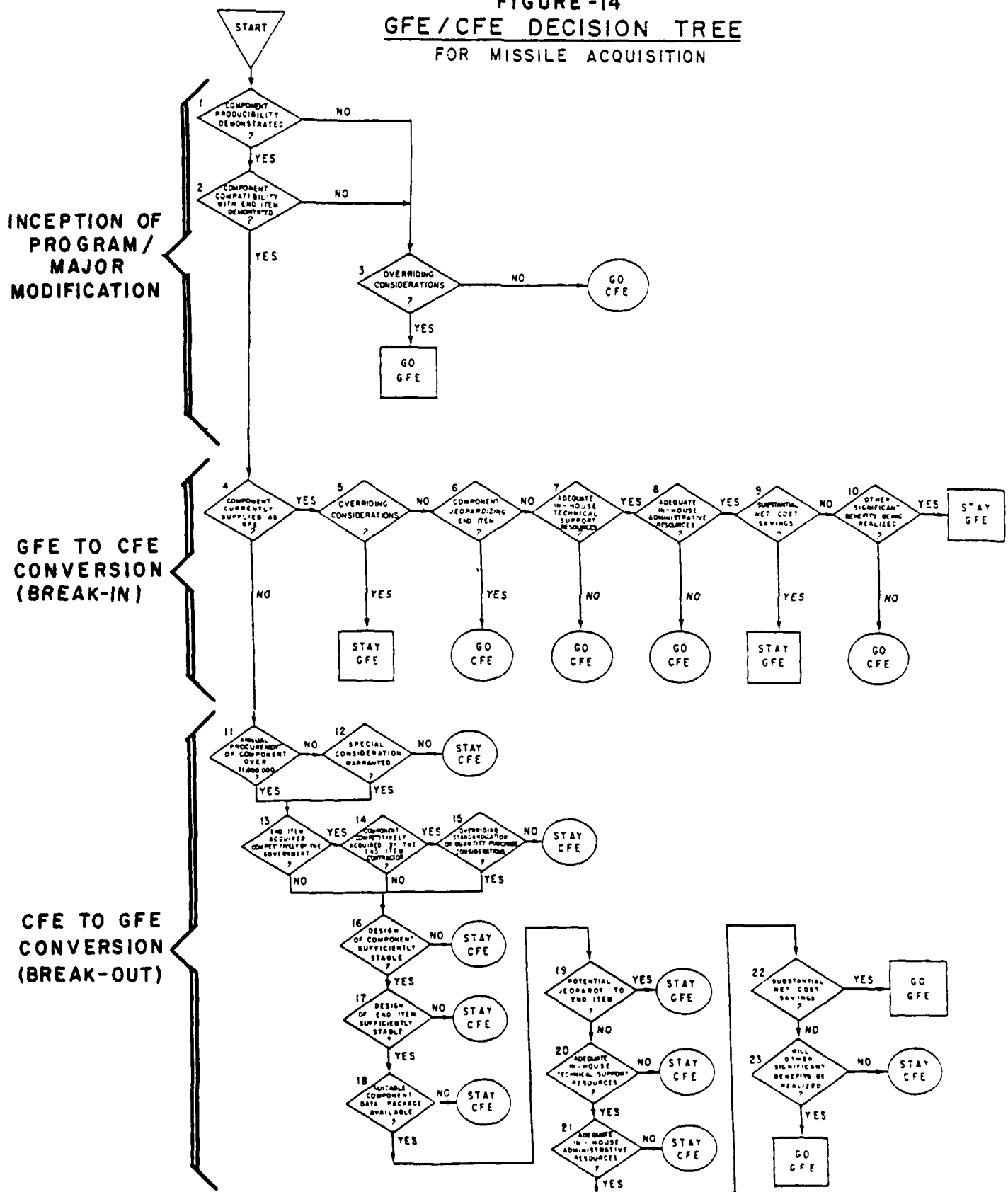


FIGURE 15

GFE/CFE DECISION TREE GUIDELINES

BOX	QUESTION	COMMENTS
1	HAS THE ABILITY TO PRODUCE THIS COMPONENT OUTSIDE OF A DEVELOPMENT OR LABORATORY ENVIRONMENT BEEN SATISFACTORILY DEMONSTRATED?	PRODUCTIBILITY NEEDS TO BE ESTABLISHED ESPECIALLY DURING THE TRANSITION FROM DEVELOPMENT TO PRODUCTION (WHERE SIGNIFICANT LOSS OF RELIABILITY OF A PRODUCT MAY BE ENCOUNTERED).
2	HAS THE COMPATIBILITY OF THIS COMPONENT IN THE END ITEM BEEN SATISFACTORILY DEMONSTRATED OUTSIDE THE DEVELOPMENT OR LABORATORY ENVIRONMENT?	THE COMPATIBILITY OF THE COMPONENT IN THE END ITEM HAS BEEN SATISFACTORILY DEMONSTRATED WHEN IT HAS BEEN ESTABLISHED THAT THE COMPONENT FUNCTIONS PROPERLY IN THE END ITEM.
3	ARE THERE ANY OVERRIDING CONSIDERATIONS WHICH MAKE IT MANDATORY THAT THIS COMPONENT BE SUPPLIED AS GFE?	OVERRIDING CONSIDERATIONS ON THE PART OF THE GOVERNMENT MAY WARRANT THAT THE COMPONENT BE SUPPLIED AS GFE EVEN THOUGH THE PRODUCTIBILITY AND COMPATIBILITY OF THE COMPONENT HAS NOT YET BEEN ESTABLISHED. EXAMPLES OF OVERRIDING CONSIDERATIONS INCLUDE (1) A COMPONENT (SUCH AS A NUCLEAR WARHEAD) WHICH IS OBTAINABLE ONLY FROM THE GOVERNMENT, (2) A COMPONENT DEVELOPED INDEPENDENTLY BY THE GOVERNMENT FOR A WIDE VARIETY OF USES, OR (3) A COMPONENT FOR WHICH STANDARDIZATION IS ESSENTIAL. OVERRIDING CONSIDERATIONS MAY ALSO ARISE FROM THE INABILITY OF THE END ITEM CONTRACTOR TO ACQUIRE A COMPONENT (E.G., A CONTRACTOR MAY LACK EITHER THE EXPERTISE IN WARHEAD PRODUCTION OR THE TECHNICAL COMPETENCE TO ACQUIRE WARHEADS.)
4	IS THE GOVERNMENT CURRENTLY SUPPLYING THIS COMPONENT TO AN END ITEM CONTRACTOR AS GFE?	CONTRACTOR FURNISHED EQUIPMENT (CFE) IS DEFINED AS ITEMS ACQUIRED OR MANUFACTURED BY A CONTRACTOR TO BE INCORPORATED INTO, OR CONSUMED IN THE PRODUCTION OF, THE PRODUCT TO BE DELIVERED UNDER THE CONTRACT. GOVERNMENT FURNISHED EQUIPMENT (GFE) IS DEFINED AS ITEMS IN THE POSSESSION OF, OR ACQUIRED BY, THE GOVERNMENT AND SUBSEQUENTLY PROVIDED TO A CONTRACTOR TO BE INCORPORATED INTO, OR CONSUMED IN THE PRODUCTION OF, THE PRODUCT TO BE DELIVERED UNDER THE CONTRACT.
5	ARE THERE OVERRIDING CONSIDERATIONS WHICH MAKE IT MANDATORY THAT THE COMPONENT BE SUPPLIED AS GFE?	SEE COMMENTS ACCOMPANYING BOX 3.

BOX	QUESTION	COMMENTS
6	IS THE FACT THAT THIS COMPONENT IS CURRENTLY PROVIDED AS GFE JEOPARDIZING, IN ANY WAY, THE ABILITY OF THE END ITEM CONTRACTOR TO SATISFACTORILY PERFORM ITS CONTRACTUAL OBLIGATIONS TO THE GOVERNMENT?	THIS QUESTION INVOLVES ASCERTAINING WHETHER SUPPLYING A COMPONENT AS GFE IS JEOPARDIZING THE QUALITY, RELIABILITY, PERFORMANCE OR TIMELY DELIVERY OF THE END ITEM.
7	DOES THE NAVY POSSESS ADEQUATE IN-HOUSE TECHNICAL RESOURCES TO SUPPORT THE PROVISION OF THIS COMPONENT AS GFE TO THE END ITEM CONTRACTOR?	ADEQUATE IN-HOUSE TECHNICAL RESOURCES MEANS THAT THE PROJECT OFFICE HAS THE SUFFICIENT NUMBER OF PERSONNEL TO PERFORM THE NECESSARY TECHNICAL SUPPORT FOR DIRECT ACQUISITION OF THE COMPONENT. SUCH SUPPORT MUST BE CONDUCTED IN A TIMELY AND COMPETENT MANNER. PROPER ATTENTION CANNOT BE DEVOTED TO THE DIRECT ACQUISITION OF THE COMPONENT IF THE CURRENT WORKLOAD IS EXCESSIVE. A LACK OF NECESSARY TECHNICAL SUPPORT PERSONNEL WOULD BE REFLECTED IN (1) AN INABILITY TO PROCESS CHANGE REQUESTS, SPECIFICATION DEVIATIONS OR REQUESTS FOR WAIVERS IN A TIMELY FASHION; (2) INORDINATE DELAYS IN PROVISIONING SPARE PARTS AND OTHER SUPPORT ITEMS; (3) THE USE OF CONTRACT PERSONNEL IN THE TECHNICAL SUPPORT CHAIN; OR (4) INADEQUATE RESPONSES TO REQUESTS BY THE PROJECT MANAGER FOR TECHNICAL SUPPORT ASSISTANCE.
8	DOES THE NAVY POSSESS ADEQUATE IN-HOUSE ADMINISTRATIVE RESOURCES TO SUPPORT THE PROVISION OF THIS COMPONENT AS GFE TO THE END ITEM CONTRACTOR?	THIS QUESTION IS SIMILAR TO QUESTION 7 BUT APPLIES TO IN-HOUSE ADMINISTRATIVE RESOURCES. A LACK OF NECESSARY IN-HOUSE ADMINISTRATIVE PERSONNEL WOULD BE REFLECTED IN THE FOLLOWING WAYS: (1) GFE PROCUREMENT REQUESTS NOT PREPARED IN A TIMELY MANNER; (2) GFE CONTRACTS PLACED SO LATE THAT THE GFE WILL NOT BE PROVIDED TO THE END ITEM CONTRACTS WHEN REQUIRED FOR TIMELY END ITEM DELIVERIES; (3) EXCESSIVE UNDEFINITE LETTER CONTRACTS OR UNPRICED CHANGE ORDERS UNDER GFE CONTRACTS; (4) INSUFFICIENT TIME AVAILABLE FOR NECESSARY IN-HOUSE CONTRACT ADMINISTRATION.

BOX

QUESTION

COMMENTS

- 9 ARE SUBSTANTIAL NET COST SAVINGS ACCRUING TO THE GOVERNMENT AS A RESULT OF THIS COMPONENT BEING SUPPLIED AS GFE TO THE END ITEM CONTRACTOR?
- WHEN PERFORMING THE COST COMPARISON TO DETERMINE WHETHER SUBSTANTIAL NET COST SAVINGS ARE ACCRUING TO THE GOVERNMENT AS A RESULT OF THE COMPONENT BEING FURNISHED AS GFE, THE ACTUAL COST OF PROVIDING SUCH GFE MUST BE ASSESSED. THUS, IN ADDITION TO THE DIRECT COMPARISON OF VENDOR COSTS, OTHER COST ELEMENTS SHOULD BE ADDED TO THE ESTIMATED PRICE OF THE COMPONENT WHEN PURCHASED DIRECTLY BY THE GOVERNMENT. THESE OTHER COST ELEMENTS INCLUDE:
- A) COST OF NECESSARY PRE-CONTRACT ACTIONS INCLUDING VERIFICATION OF DATA PACKAGE, PREPARATION AND PROCESSING OF PROCUREMENT REQUESTS, PERFORMANCE OF COST ANALYSIS, PREPARATION FOR AND CONDUCT OF CONTRACT NEGOTIATIONS AND REVIEWS, AND THE PREPARATION AND REVIEW OF THE CONTRACTUAL INSTRUMENT.
 - B) COST OF FIELD CONTRACT ADMINISTRATION (THIS COST IS SET AT 4% OF CONTRACT PRICE IN OMB CIRCULAR A-76).
 - C) COST OF IN-HOUSE TECHNICAL AND ADMINISTRATIVE SUPPORT NECESSARY FOR CONTRACT PERFORMANCE. (WHEN THE COMPONENT IS ALREADY GFE, ADEQUATE DATA ON THE TIME REQUIRED FOR THIS TYPE OF SUPPORT SHOULD BE READILY AVAILABLE.)
 - D) THE COST OF TRANSPORTATION OF THE COMPONENT TO THE END ITEM CONTRACTOR. (SINCE THIS TRANSPORTATION WILL NORMALLY BE ON GOVERNMENT BILLS OF LADING, THIS COST WILL HAVE TO BE OBTAINED FROM THE MILITARY TRAFFIC MANAGEMENT COMMAND (EASTERN DIVISION AUTOVON IS 274-7117). IN ADDITION TO THE COMMON CARRIERS' CHARGE, THE COST OF PROVIDING ANY GOVERNMENT FURNISHED CONTAINERS FOR THE COMPONENT SHOULD ALSO BE IDENTIFIED.)
 - E) THE COSTS, IF ANY, OF STORAGE OF THE COMPONENT AS GFE. (THIS WOULD CONSIST OF ANY BONDED STORAGE AND SECURITY COSTS AT THE END ITEM CONTRACTOR'S PLANT RESULTING FROM THE NEED TO SEGREGATE, PROTECT AND ACCOUNT FOR GFE.)

BOX

QUESTION

9 (CONT'D)

COMMENTS

- f) THE COSTS OF ANY OFF-SITE TESTING OF THE COMPONENT WHICH WOULD NOT BE NECESSARY IF THE COMPONENT WAS TO BE CFE.
- g) THE COSTS, IF ANY, WHICH THE GOVERNMENT INCURS BECAUSE OF LATE DELIVERY OF THE COMPONENT TO THE END ITEM MANUFACTURER.

10 ARE THERE SIGNIFICANT BENEFITS ACCRUING TO THE GOVERNMENT AS A RESULT OF PROVIDING THIS COMPONENT AS GFE, WHICH OFFSET THE RESPONSIBILITIES THAT THE GOVERNMENT ASSUMES WHEN IT SUPPLIES GFE?

EVEN THOUGH SUBSTANTIAL NET COST SAVINGS ARE NOT ACCRUING TO THE GOVERNMENT FROM PROVISION OF THE COMPONENT AS GFE, THERE MAY BE OTHER SIGNIFICANT BENEFITS TO THE GOVERNMENT WHICH ARE HIGHLY DESIRABLE. IF THESE BENEFITS CANNOT BE ACCOMPLISHED UNDER A CFE PROCUREMENT, AND IF THE BENEFITS ARE NOT OUTWEIGHED BY THE RISK ASSUMPTION INHERENT IN SUPPLYING GFE, THIS BOX MERITS AN AFFIRMATIVE RESPONSE. SOME OF THE POTENTIAL BENEFITS WOULD INCLUDE:

- A) MULTIPLE SOURCING FOR MOBILIZATION CAPABILITY PURPOSES;
- B) SMALL OR MINORITY BUSINESS PARTICIPATION IN PROGRAM;
- C) LABOR SURPLUS AREA PARTICIPATION IN PROGRAM; D) INCREASE IN COMPETITIVE PROCUREMENT.

11 IS THE ESTIMATED COST OF THIS COMPONENT TO THE GOVERNMENT \$1,000,000 OR MORE PER ANNUAL BUY?

THIS QUESTION FOCUSES ATTENTION ON HIGH DOLLAR VALUE COMPONENTS AS POTENTIAL GFE CANDIDATES. SUCH CANDIDATES SHOULD BE SELECTED ON THE BASIS OF A PRELIMINARY ASSESSMENT OF THE POTENTIAL COST SAVINGS IF THE CONVERSION TO GFE IS MADE.

12 DO OTHER CIRCUMSTANCES OR REASONS EXIST WHICH WARRANT FURTHER CONSIDERATION AS TO WHETHER THIS COMPONENT SHOULD BE PROVIDED AS GFE?

SOME COMPONENTS WITH AN ANNUAL PROCUREMENT VALUE OF LESS THAN \$1,000,000 MAY STILL WARRANT CONSIDERATION AS POTENTIAL GFE, PROVIDED THE NATURE OF THE COMPONENT OR THE CIRCUMSTANCES INVOLVED MERIT SUCH TREATMENT. EXAMPLES OF SUCH COMPONENTS INCLUDE (A) SET-ASIDES FOR SMALL BUSINESS, MINORITY BUSINESS OR LABOR SURPLUS AREAS; (B) SECOND SOURCING (WHICH COULD NOT BE ACCOMPLISHED VIA THE CFE METHOD); OR (C) COMPONENTS WHICH ARE CRITICAL FOR SOME REASON AND MUST BE PROCURED DIRECTLY BY THE GOVERNMENT. (NOTE, HOWEVER, THAT AN AFFIRMATIVE ANSWER TO THIS QUESTION DOES NOT RESULT IN A GFE DECISION AT THIS POINT, BUT RATHER PERMITS THE DECISION-MAKER TO PROCEED WITH THE GFE/CFE ANALYSIS.)

BOX	QUESTION	COMMENTS
13	Is it anticipated that the contract for the end item will be awarded without adequate price competition?	SELF-EXPLANATORY.
14	Is it expected that the end item contractor will acquire this component without adequate price competition?	SELF-EXPLANATORY.
15	Will substantial net cost savings accrue to the Government (a) from greater quantity purchases or (b) from such factors as improved logistics support through reduction in varieties of spare parts and economies in operations and training through standardization of design?	<p>EVEN IF COMPETITION IS BEING OBTAINED ON BOTH THE END ITEM AND THE COMPONENT, OTHER FACTORS MAY EXIST WHICH WILL OFFER SUBSTANTIAL NET COST SAVINGS FROM PROVISION OF THE COMPONENT AS GFE. THERE ARE TWO FACTORS WHICH MAY RESULT IN SAVINGS: (1) GREATER QUANTITY PURCHASES, OR (2) IMPROVED LOGISTICS COSTS RESULTING FROM STANDARDIZATION OF DESIGN. COGNIZANT TECHNICAL PERSONNEL SHOULD BE ASKED WHETHER A COMPONENT IS BEING UTILIZED IN OTHER WEAPON SYSTEMS TO DETERMINE WHETHER SUCH SAVINGS MIGHT BE POSSIBLE. IF A MULTI-USE COMPONENT IS INVOLVED, THE CONTRACTS GROUP SHOULD PROVIDE DATA ON POTENTIAL COST SAVINGS THROUGH COMBINED QUANTITY PURCHASES AND THE LOGISTICS/FLEET SUPPORT GROUP SHOULD PROVIDE DATA ON THE POTENTIAL FOR SAVINGS IN LOGISTICS COSTS THROUGH STANDARDIZATION OF DESIGN.</p>
16	Is the design of this component sufficiently stable so that further design or engineering effort by the end item contractor is unlikely to be required?	<p>THIS QUESTION SHOULD BE ADDRESSED TO BOTH THE TECHNICALLY COGNIZANT DESK AND TO THE CLASS DESK OFFICER. A GOOD MEASURE OF THE STABILITY OF A COMPONENT WOULD BE THE NUMBER OF ENGINEERING CHANGE PROPOSALS IT ENGENDERS AND THE NUMBER AND SIGNIFICANCE OF ANY AUTHORIZED WAIVERS OR DEVIATIONS. CONSIDERATION SHOULD ALSO BE GIVEN TO THE POSSIBILITY OF CHANGES TO THE COMPONENT DURING THE FORTHCOMING PROCUREMENT.</p>
17	Is the design of the end item, insofar as it will affect this component, sufficiently stable so that further design or engineering effort by the end item contractor is unlikely to be required?	<p>EVEN THOUGH THE DESIGN OF THE COMPONENT IS EXPECTED TO REMAIN STABLE, THE USE OF GFL, WHEN CHANGES TO THE END ITEM ARE CONTEMPLATED WILL TEND TO NEGATE THE END ITEM CONTRACTOR'S RESPONSIBILITIES.</p>

BOX

QUESTION

18 Does the Government possess a suitable data package with rights to use it for direct acquisition of this component?

COMMENTS

It is essential that the Government be able to adequately describe any component which is to be procured directly and furnished as GFE to an end item contractor. If the component must be manufactured to detail specifications, a complete data package must be available. This should include manufacturing drawings, process and procedure charts, test and inspection procedures, etc. The validity of the package should be established in actual practice before it is used for a major procurement from another manufacturer. Finally, the Government must have the rights to use the data package for reproduction.

19 Will provision of this component as GFE jeopardize the quality, reliability, performance, or timely delivery of the end item?

Since all GFE pose a potential jeopardy to the end item procurement, this question involves an assessment of the degree of potential jeopardy. If the end item contractor is already experiencing problems with the component producer, providing the component as GFE will undoubtedly further jeopardize the end item by introducing a third party into the process. If the end item contractor is required to provide greater support or surveillance to the component manufacturer than would ordinarily be expected, or greater than the Government can reasonably be expected to provide, providing the component as GFE will in all probability further jeopardize the end item. The advice of the cognizant administrative contracting officer at the component manufacturer's plant should be sought to determine whether this manufacturer meets its quality, performance and delivery requirements.

20 Does the Navy possess adequate in-house technical resources to support the provision of this component as GFE to the end item contractor?

To determine whether adequate in-house technical support resources exist, see the comments accompanying box 7.

BOX	QUESTION	COMMENTS
21	DOES THE NAVY POSSESS ADEQUATE IN-HOUSE ADMINISTRATIVE RESOURCES TO SUPPORT THE PROVISION OF THIS COMPONENT AS GFE TO THE END ITEM CONTRACTOR?	TO DETERMINE WHETHER ADEQUATE IN-HOUSE ADMINISTRATIVE RESOURCES EXIST, SEE THE COMMENTS ACCOMPANYING BOX 8.
22	WILL BREAKOUT OF THIS COMPONENT RESULT IN SUBSTANTIAL NET COST SAVINGS TO THE GOVERNMENT?	TO DETERMINE WHETHER SUBSTANTIAL NET COST SAVINGS MAY ACCRUE TO THE GOVERNMENT IF THE COMPONENT IS PROVIDED AS GFE, SEE THE COMMENTS ACCOMPANYING BOX 9.
23	WILL OTHER SIGNIFICANT BENEFITS ACCRUE TO THE GOVERNMENT AS A RESULT OF BREAKING OUT THIS COMPONENT?	TO DETERMINE WHETHER OTHER SIGNIFICANT BENEFITS WILL ACCRUE TO THE GOVERNMENT, SEE THE COMMENTS ACCOMPANYING BOX 10.

APPENDIX A

SUMMARY OF ACQUISITION PROCESS FOR NAVAIR MISSILES

SPARROW

The SPARROW AIM 7F is an air-launched guided missile used by both the Navy and the Air Force. NAVAIR procures the missiles for both services. The guidance, control and propulsion sections were developed for NAVAIR by Raytheon under contracts awarded in FY63. The integrated warhead assembly (metal parts, explosive charge and S&A device) was developed by NWC, China Lake.

The SPARROW missile has always been acquired in sections. Navy missile components are delivered to naval weapons stations for assembly by Government personnel prior to issuance for service use. Air Force missiles are assembled at the squadron level. Individual components for the Air Force are delivered to the Army's Letterkenny arsenal pending shipment to Air Force installations. The major component manufacturer, Raytheon, does not possess the facilities necessary for safe handling of loaded rocket motors and warheads or for the assembly of the missile.

The major components of the SPARROW and their development are summarized below.

Guidance Sets, Mark 17, Mod 0, Including Wings, Fins, Radomes and Fuze Triggering Device (G&C): The G&C section is procured as a single component. Raytheon developed the G&C under a NAVAIR contract. During FY74 a second source competition was conducted and General Dynamics was selected. Subsequent procurements have been split between both contractors on a competitive price basis. Completed units are shipped to NWS Yorktown and Concord for Navy missiles and to Letterkenny Arsenal for Air Force requirements.

The propellant grain for the G&C unit is GFE. It is procured by a MIPR from NAVAIR through Rock Island Arsenal and sent to the Radford Ammunition Plant.

Radford provides the grain to the Bermite Company, a subcontractor to both Raytheon and General Dynamics.

Reusable containers for the G&C units are provided to both contractors as GFE. NAVAIR arranges for providing adequate supplies to the contractors (the Navy and the Air Force use different containers), for refurbishing damaged Navy containers and for purchasing additional Navy containers, as required.

Warhead, Mark 71, Mod 0: Warheads for the SPARROW are assembled and loaded at NWSC, Crane. Warheads consist of the metal parts and the explosive charge.

The metal parts were developed by the Midway Company under contracts awarded during FY69. From FY72 through FY78 NAVAIR awarded Engineering Research, Inc. (ERI) all production contracts for the metal parts. In FY79, the metal parts were included in the G&C contracts with Raytheon and General Dynamics. These contractors will subcontract for the metal parts and provide for their delivery to Crane. NAVAIR has Crane procure protective caps for the warhead and supply these caps to the metal parts contractor as GFE. The completed metal parts are shipped to Crane by the contractors. Reusable containers for the warhead metal parts are now being provided by NAVAIR as GFE for Air Force items only.

The explosive charge for the warhead is acquired by means of a Request for Contractual Procurement (RCP) issued by NAVAIR to Crane. Crane then purchases the charge (PBXN) from Chemtronics. The Mark 38 Warhead Booster is manufactured by Crane under a Work Request (WR) from NAVAIR. Assembly and loading of the warhead is performed by Crane under the same WR.

The complete warheads (including the S&A device) are shipped from Crane to Yorktown and Concord for assembly into the complete missile. Air Force units are sent to Letterkenny Arsenal.

Safety and Arming Device Mark 33, Mod 0, Including Containers (S&A): The S&A device is procured under NAVAIR contracts. The Mark 33, Mod 0 S&A was developed by the Barry Miller Co. under a contract awarded during FY67. The FY73 contract was awarded to Piqua Engineering, Inc. The FY74 and subsequent requirements have been split on a competitive price basis between Piqua and Raymond Engineering.

Completed S&A units are shipped by the contractors to NWSC Crane and assembled into the warheads before shipment to the final assembly point. During FY79, NAVAIR attempted to combine the S&A with the G&C procurement. This attempt failed after the current producers and the Small Business Administration protested on the grounds that it could result in loss of contracts for small business.

Rocket Motor, Mark 58, Mod 3: This motor was developed by Hercules under a subcontract from Raytheon in FY67. The FY73 requirement for motors was broken out and NAVAIR has contracted directly with Hercules for all subsequent requirements. One of the ingredients of the rocket motor propellant (PBX N-4) is ordered by NAVAIR from NOS Indian Head and provided as GFE to Hercules. Motor containers for Air Force missiles are reusable and are provided to Hercules in the same manner as those for the G&C units. Motor containers for Navy missiles are not reusable.

Summary of Major Procurement Actions Per Year Required to Purchase SPARROW Missiles

- 1 procurement request and 2 contracts for G&C units
- 1 procurement request and 2 contracts for warhead metal parts*
- 1 procurement request and 2 contracts for S&A devices
- 1 procurement request and 1 contract for rocket motors
- 1 MIPR for propellant grain for Navy missiles
- 1 MIPR for propellant grain for Air Force missiles
- 1 MIPR for propellant grain for FMS missiles
- 1 MILSTRIP for Navy G&C containers for Raytheon from Yorktown
- 1 MILSTRIP for Navy G&C containers for Raytheon from Concord
- 1 MILSTRIP for Navy G&C containers for General Dynamics from Yorktown
- 1 MILSTRIP for Navy G&C containers for General Dynamics from Concord
- 1 notice to Ogden ALC for Air Force G&C containers
- 1 RCP to Crane to purchase PBXN explosives
- 1 RCP to Crane to purchase warhead protective caps
- 1 WR to Crane for Navy warhead booster and loading
- 1 WR to Crane for Air Force warhead booster and loading
- 1 WR to Crane for FMS warhead booster and loading
- 1 notice to Ogden ALC for Air Force motor containers

- 1 project order each to NWS Yorktown and Concord for missile assembly and test
- 1 project order to Indian Head for Rocket Motor Propellant

*Not required for FY79 procurement.

SIDEWINDER

The SIDEWINDER AIM 9L is an air-launched guided missile purchased by NAVAIR for use by both the Navy and the Air Force. The basic missile was designed and developed by NWC, China Lake which also manufactured the prototype version (AIM 9A). It was first fired in 1953.

One version of the SIDEWINDER, the AIM-9J, is manufactured, assembled and shipped as an AUR by Ford Aeronutronic under contracts placed by the Air Force. Except for the AIM-9J, no contractor capability for assembly and test of the complete AIM-9 missile has ever been established, and the AIM-9 missiles have always been procured in sections which are delivered to weapons stations for final assembly. The Air Force components are shipped to Letterkenny Arsenal.

The major components of the SIDEWINDER and their development is summarized below.

Guidance and Control Section AN/DSQ-29 (GCS): The GCS section is procured as a single component. Earlier versions of this section for the AIM-9B were produced by General Electric Co. and Ford Aeronutronic. Currently there are two sources for the AIM-9L GCS: Raytheon and Ford. Each year's requirement is split between these two companies on a price-competitive basis. Completed units for NAVAIR are shipped to Yorktown and Fallbrook for assembly by Government personnel. Air Force units are shipped to Letterkenny.

The manufacturer of a special steel used in the GCS units ceased production several years ago. NAVAIR bought the residual inventory because there was no other producer. Necessary quantities are now provided to the GCS manufacturers as GFM.

Containers for the GCS units are GFE. Different containers are used by the Air Force and the Navy. NAVAIR arranges for provision of adequate supplies of containers to the GCS manufacturers.

Warhead, WDU-17/B: Prior to FY79, the warhead was manufactured by NWSC Crane. Crane contracted for the required metal parts and obtained the explosive charge material from Army arsenals. In FY79, competitive contracts were awarded to two companies, TRW and Marquardt, for manufacture of the complete warhead. Each of these firms has teamed with explosives processors who will be their subcontractors for this task. The explosive material itself will be GFE to the contractors.

Completed warheads for NAVAIR will be shipped to the weapon stations for assembly by Government personnel, while the Air Force units will be shipped to Letterkenny. Containers for the warhead are GFE. Although Navy and Air Force use different containers, NAVAIR arranges for the provision of all containers to the contractors.

Safety & Arming Device Mark 13, Mod 2 (S&A): These sections of the SIDEWINDER are procured from two sources. The current manufacturers are Micronics and Piqua Engineering (each a small business concern). The quantity awarded each firm is based on competitive prices. A proposal to combine the S&A with the GCS procurement in FY79 was rejected when small business interests protested the plan.

Completed items are shipped to Yorktown, Fallbrook, and Letterkenny. Containers are GFE, with NAVAIR arranging for the provision of all containers to the contractors.

Target Detector DSU-15/B (TDD): This device was initially produced by Santa Barbara Research Center. Martin Marietta was introduced as a second source in FY76. Current buys are split between the two companies on a price-competitive basis. The completed units go to Yorktown, Fallbrook and Letterkenny from the contractor's plants. Containers are provided as GFE by NAVAIR even though the Navy and Air Force use different containers.

Wings, Mark 1, Mod 0: Wings have been purchased by NAVAIR under formal advertising procedures. The previous contractor was Chaparral Industries. The FY78 requirement was awarded to ERI. The current plan for FY79 is to split the procurement between two sources for mobilization planning purposes.

Completed wings are shipped by the manufacturer to the assembly point. Containers are provided as GFE by NAVAIR even though the Navy and Air Force use different containers.

Fins, BSU-32/B: Fins have been purchased by NAVAIR under formal advertising procedures. The FY78 buy was awarded to Welbilt. Previous contractors were Anodic, Genii Research, and Precision Metal. The current plan for FY79 is to split the procurement between two sources for mobilization planning purposes.

Completed units are shipped by the manufacturer to Yorktown, Fallbrook and Letterkenny. GFE containers are provided only for the Air Force requirements. Navy requirements are shipped in non-reusable containers.

Rocket Motor MK-36, Mod 7: The SIDEWINDER motor was developed by NWC China Lake, and the first version was produced by the Naval Propellant Plant (now NOS Indian Head). Motors for later versions of SIDEWINDER were manufactured by Bermite and Rocketdyne (now Hercules). Current requirements for the Mark 36, Mod 7 are split between Bermite and Hercules on a competitive basis.

As with all other components, the motors are sent to Yorktown, Fallbrook and Letterkenny after manufacture. Containers are supplied as GFE by NAVAIR even though the Navy and Air Force use different containers.

Summary of Major Procurement Actions Per Year Required to Purchase SIDEWINDER Missiles

- 2 procurement requests and 2 contracts for GCS units
- 2 procurement requests and 2 contracts for S&A devices
- 2 procurement requests and 2 contracts for rocket motors
- 2 procurement requests and 2 contracts for TDDs
- 2 procurement requests and 2 contracts for wings
- 2 procurement requests and 2 contracts for fins

- 2 procurement requests and 2 contracts for warheads
- 3 MIPR to ARCOM Rock Island to authorize GFE explosive to warhead manufacturers
- 1 memo to authorize GFE special steel to GCS manufacturers
- 1 series of orders to arrange for shipment of the GFE containers to each contractor except the fin manufacturer
- 1 project order each to NWS Yorktown and Concord for missile assembly and test

SHRIKE

The SHRIKE AGM-45 is an air-launched missile purchased by NAVAIR for use by both the Navy and Air Force. The SHRIKE was designed and developed by NWC China Lake, beginning in 1962. It has always been procured in sections and assembled at Government installations. No contractor capability for assembly and test has ever been established by NAVAIR.

There are no current Navy requirements for further SHRIKE missiles and Air Force requirements run only through FY79. Since the time this report was prepared, the Air Force has cancelled its FY79 procurement of SHRIKE missiles.

The components of the Shrike are as follows:

Guidance Set, Mark 49, Mod 0, With Mark 5, Mod 1 Electronic Assembly, Mark 29, Mod 0 Fuze Antenna, Including Container: This guidance set represents an improved version of earlier SHRIKE guidance sets. It was designed by NWC China Lake and Texas Instruments, who is the sole source producer. The electronic assembly (target detection device) was broken out for competitive purposes and for small business set-asides. However, repeated failures to perform by the various contractors led to a decision to combine this item with the guidance set procurement from Texas Instruments. Current (FY79) contracts are all Air Force requirements which will be shipped to the Letterkenny Arsenal.

Control Section Mark 5, Mod 0: The procurement of this section was separated from the guidance section in the combined FY76/77 procurement in an effort to promote

competitive procurement. As in an earlier attempt to obtain competition, the winner of the formally advertised contract experienced difficulties in production, so the FY78 procurement was directed to the only available experienced producer, Texas Instruments.

Warhead Assembly: The warhead assembly consists of a set of metal parts, a fuze, a booster, an armament cable and the explosive charge.

NAVAIR contracts for the metal parts and the armament cable by formal advertising procedures. This results in frequent changes of suppliers. In FY78 the metal parts were purchased from a company called ATI. The armament cable contractor was Mil-Tec.

NAVAIR normally contracts for the fuze S&A with two sources in order to maintain adequate sources of supply. Each year's procurement was split on a price-competitive basis between Raymond Engineering (a small business) and Bulova. However, the low quantity requirement in FY78 precluded such a split, and Bulova received the entire quantity under a competitively negotiated procurement.

The booster is manufactured by NWSC Crane on the basis of a project order issued by NAVAIR.

All parts for the warhead are shipped by the manufacturers to NOS Indian Head. NAVAIR issues a project order to Indian Head providing for fabrication and loading of the explosive charge into the warhead. Indian Head gathers and mixes all the ingredients of the explosive charge, assembles and loads the warhead, and delivers the completed warhead to the Letterkenny Arsenal.

Wings, Mark 2, Mod 1 & Fins, Mark 21, Mod 0: Wings and fins are combined for procurement purposes and formal advertising procedures are followed. A protest regarding the wording of the IFB necessitated award of two contracts for the FY77 program, one for wings and one for fins. The FY78 wings and fins requirement was awarded to Lockley. Completed wings and fins are shipped to the guidance set manufacturer, packed with the guidance set, and then forwarded to Letterkenny.

Rocket motor: The initial SHRIKE motor was produced by Rocketdyne (now Hercules). In 1967, Aerojet was introduced as a second source supplier. These two producers have supplied all requirements since then.

Containers: NAVAIR arranges for the provision of GFE containers to the producers of the guidance and control sets, the warhead metal parts, the fuzes and the rocket motors.

Summary of Major Procurement Actions Per Year Required to Purchase SHRIKE Missiles

- 1 procurement request and 1 contract for guidance sets
- 1 procurement request and 1 contract for control sets
- 1 procurement request and 1 contract for wings and fins
- 1 procurement request and 1 contract for warhead metal parts
- 1 procurement request and 2 contracts for fuzes
- 1 procurement request and 1 contract for armament cables
- 1 procurement request and 1 contract for rocket motors
- 1 project order to Crane for boosters
- 1 project order to Indian Head for warhead loading and assembly
- 1 series of MILSTRIPS for providing GFE containers to section manufacturers

PHOENIX AIM-54A

The PHOENIX missile was developed as an integral part of the F-14 weapon system. The prime missile contractor, Hughes, was selected through a design competition conducted by NAVAIR during 1962. Hughes had responsibility for development of the guidance, control and propulsion sections of the missile. The armament sections (fuze, triggering device, explosive lead, fuze booster, electronic assembly, antennas, and warhead metal parts) were developed by NWC China Lake and integrated into the missile by Hughes.

The use of Hughes as the integrating contractor in lieu of a weapons station was consistent with guidelines established by the Chief of Naval Material in CNM letter MAT 0256 RTW to Com NAVAIR dated 4 August 1969. All sections not purchased through

Hughes are provided to Hughes as GFE. The major components of the Phoenix and their development are as follows:

Guidance and Control Section (G&C): The major section of the missile, the G&C was designed and developed by, and has only been procured from, Hughes. All other sections are integrated by Hughes into the complete missile before delivery to fleet loading facilities.

Fuze, Mark 334, Mod 0: The design and development of this component was coordinated by NWC China Lake. Aerojet produced the prototypes, and Barry Miller Ordnance manufactured the pilot production. A competitive procurement in FY72 was won by Micronics Division of FMC, and all subsequent procurements have been made from Micronics.

While this fuze is provided to Hughes as GFE, Micronics also receives GFE for the fuze. To consolidate requirements, NWC China Lake purchases detonators common to this and other missiles and furnishes them to Micronics as GFE.

Fuze Triggering Device, Mark 13, Mod 0: This item was designed by NWC China Lake with assistance from Endevco Corp., which has been the sole source producer ever since.

Explosive Lead Mark 22, Mod 0: This component was designed by NWC China Lake. Explosive Technology Division of Ducommun Inc. refined the design and produced all requirements through FY74. In FY75, Reynolds Rocket Systems won a competitively negotiated award. Formal competition as a small business set-aside is conducted for current requirements. The FY78 producer was Reynolds Rocket Systems.

Fuze Booster, Mark 60, Mod 1: This item was designed by NWC China Lake. All production quantities have been purchased either from Reynolds Rocket Systems or Special Devices by formal advertising as a small business set-aside.

Target Detecting Device (Electronic Assembly and Antenna): This item was designed by NWC China Lake. Engineering development was contracted with Bendix Corp. Upon completion of development, the antennas and the electronic assembly were broken out for separate procurement. Bendix has been the sole source for the electronic assembly, and Systron Donner is the sole source for the antennas.

Warhead: This component was designed and developed by NWC Dahlgren. The metal parts were machined and assembled by TRW through pilot production. Due to technical problems with the plastic warhead cases, in FY71 the cases were broken out, purchased from Swedlow, and furnished as GFE to TRW. Currently, several producers are capable of producing these cases, and in FY79 the cases will be CFE, and will be competitively procured by the prime warhead contractor.

For FY79, Chamberlain Manufacturing Co. has qualified as a second source for warheads. The FY79 solicitation was issued competitively, and included options for two additional years. The empty warhead assemblies are sent to NWS Yorktown for loading, then sent as GFE to Hughes for final missile assembly. To accomplish this, NAVAIR will let a prime contract for the empty warhead assemblies to be delivered to NWS Yorktown. NAVAIR issues a MIPR to Rock Island Arsenal authorizing purchase of the explosives, and a project order to NWS Yorktown for loading the warheads and delivery of complete units to Hughes.

The steel used in the warhead has extremely rigorous physical requirements, and only one source, which has refused to continue manufacturing it. In the past, NAVAIR has procured extra steel and has sufficient reserves for the FY79 and the planned FY80 buys. NSWC Dahlgren has negotiated an agreement to produce one more "heat" or lot of this steel, which should be sufficient to supply several years' requirements. In the FY79 procurement, the steel will be GFE to the contractor.

Propulsion Section with Mark 47, Mod 0 Rocket Motor: The propulsion section of the PHOENIX was designed under subcontracts from Hughes to Rocketdyne and Aerojet. In FY73 NAVAIR broke out the motor and awarded prime contracts to both firms for production quantities of motors. In the FY74 program, the entire quantity was awarded to Rocketdyne on a competitive price basis. The FY75 procurement was also won by Rocketdyne. In FY76 Aerojet declined to participate in the competition leaving Rocketdyne (now Hercules) as the only source for this component.

Containers: NAVAIR must provide containers for missile sections and complete missiles. Sectional containers, which are reusable, are acquired through competitive procurements and provided to section manufacturers by NAVAIR. Missile containers were developed by the NWS Earle and until 1975 were procured sole-source from Plastics Research. Since 1976 they have been procured through formal advertising as small business set-asides, and there have been continual problems with them. New containers have been developed, and plans are to procure current requirements to the new specifications on a competitive basis.

Summary of Major Procurement Actions Per Year Required to Purchase PHOENIX

- 1 procurement request and 1 contract for complete missiles
- 1 procurement request and 1 contract for warhead assemblies
- 1 procurement request and 1 contract for fuze triggering devices
- 1 procurement request and 1 contract for fuze
- 1 procurement request and 1 contract for propulsion section
- 1 procurement request and 1 contract for fuze booster
- 1 procurement request and 1 contract for explosive lead
- 1 procurement request and 1 contract for antennas
- 1 procurement request and 1 contract for electronic assembly
- 1 procurement request and 1 contract for missile containers
- 1 MIPR to Rock Island Arsenal for explosives
- 1 project order to NWS Yorktown for loading of warheads
- 1 project order to NWC China Lake to provide detonators as GFE to Micronics
- Series of MILSTRIPS to provide section containers to manufacturers

HARPOON

The HARPOON is an anti-ship missile designed to be launched from aircraft, ships, and submarines. The prime missile contractor, McDonnell Douglas, was selected through a design competition conducted by NAVAIR in 1971.

McDonnell was responsible for development of the guidance, control, sustainer and booster sections of the missile. The engine and the ordnance (warhead) section were provided to McDonnell as GFE during the design and prototype phases of the program. During these phases, McDonnell performed system integration and assured compatibility of the various sections through associate contractor relationships (mandated by the prime contract) with the GFE suppliers. Beginning with the pilot production phase of the program, only the engine was provided as GFE to McDonnell and the missile assembly function was performed by NWS Concord. McDonnell delivered each of the various components of the HARPOON for which it was responsible to Concord for assembly.

Reliability problems and the inability to establish responsibility for system performance have resulted in a change in the HARPOON acquisition plan. Beginning in FY77 McDonnell assembled the missile (except for the launch mode items) into what is called a HARPOON Missile Body (HMB). McDonnell will also deliver the kits that adapt the HMB to the individual launch mode required by the user, including the booster used in surface launchings.

For all practical purposes, the HMB is an AUR missile. The major components of the HARPOON and their development are as follows.

Guidance Control & Sustainer Sections: These major sections of the missile are designed, developed, and produced solely by McDonnell.

Engines J402-CA-400: The HARPOON uses a gas turbine engine. The producer, Teledyne CAE, was chosen through a competitive design process by NAVAIR. Engines are provided as GFE to McDonnell.

Ordnance Section: The HARPOON ordnance section consists of the warhead housing, the explosive charge, the fuze and a pressure probe. The fuze and pressure probe were developed by Raymond Engineering. A second source is to be established during FY79. Contracts for these items were let by NRPO Long Beach under NWC China Lake direction until the FY 197T/77 buy, which was contracted for directly by NAVAIR.

The warhead housing was developed and is manufactured by NOS Louisville. Explosive loading is done by NWS Yorktown and is furnished as GFE to McDonnell.

Launch Mode Items: It is necessary to prepare the basic missile with special hardware compatible with the intended launch mode: air, surface or submarine. To accommodate this need, McDonnell manufactures launch kits, capsules, and cannister tubes. These items are not attached to missiles since the numbers and the mix depend on fleet needs at any given time. McDonnell delivers these items to NWS Concord for attachment at the time of fleet load-out. When specific configurations are known, as in the case of FMS, McDonnell will incorporate the launch mode hardware into the product it delivers, beginning with the FY78 procurement.

Summary of Major Procurement Actions Per Year Required to Purchase HARPOON Missile

- 1 procurement request and 1 contract for HMBs and launch mode items
- 1 procurement request and 1 contract for engines
- 1 procurement request and 1 contract for fuzes and pressure probes
- 1 RCP for warhead casings and loading
- 1 RCP for containers to NOS Louisville

APPENDIX B

MISSILE TEST PROCEDURES

MISSILE PROGRAM	COMPONENT	GQC	S&A	TARGET DETECTOR	ROCKET MOTOR
PHOENIX		Tested at unit, section, and AIR level. Formal acceptance at AIR test level.	Tested at contractor plant before delivering to Hughes. NMSC Crane receives a portion of each lot for GLAT. Hughes does a pre-assembly check of the S&A before final assembly.	Contractor quality control and testing. Sample from each lot to NMSC Crane for GLAT. NMSC does a pre-assembly check. NOTE: Includes antenna assembly.	Contractor quality control and testing. Samples from each lot are test fired at contractor facility with NAVPRO on hand for acceptance.
	HARPOON	Tested at section and AIR level.	Contractor testing & quality control. Sample from each lot goes to NMSC Crane for product reliability test.	N/A	Contractor quality control and testing. Motor is GIE to NMSC.
SIDEWINDER		Full functional test conducted by contractor prior to delivery. Navy conducts a 100% GD/NO-GD test on each GQC prior to assembly.	Contractor performs in-process testing & quality control. Navy performs a GLAT at NMSC Crane. Lots then delivered for final assembly. No check-out prior to assembly.	Contractor performs extensive in-process quality control. Unit is hermetically sealed for delivery. Navy conducts a GD/NO-GD test prior to assembly.	Contractor in-process & quality control checks. Contractor conducts test firings from each lot with NAVPRO on hand for acceptance. GD/NO-GD test of firing circuitry prior to assembly.
	SPARROW	Contractor full function test and reliability demonstration. Navy performs pre-assembly inspection.	100% acceptance testing at manufacturing plant. Contractor quality control & inspection. Lots shipped to NMSC Crane for GLAT.	Contractor performs full function, environmental and reliability demonstration test. Navy performs pre-assembly inspection & test.	3-5 motors/lot are test fired by contractor, at contractor plant. All motors subjected to a pre-assembly inspection & test of firing circuitry by Navy.
SHRIKE		Contractor full function test and reliability demonstration. Navy performs GLAT at PMIC GLAT can be: 1. a repeat of contractor tests; 2. a captive flight; or 3. flight test simulation.	Contractor in-process testing and quality control. 100% acceptance testing of completed units done by contractor. Units then shipped to NMSC Indian Head for warhead assembly.	Testing antenna and electronic assembly, both major sub-assemblies of GQC are tested separately. Then delivered to the GQC contractor. Contractor performs verification test prior to assembly of GQC.	Samples from each lot are test fired by contractor at his facility. Navy accepts after successful demonstration. Navy re-tests firing circuitry prior to assembly.

MISSILE TEST PROCEDURES

MISSILE PROGRAM	COMPONENT	G&C	S&A	TARGET DETECTOR	ROCKET MOTOR
PHOENIX		N/A	Tested at unit, section, and AUR level. Formal acceptance at AUR test level.	Sample testing. 1 unit/month is test fired at NMSC Dahlgren. No test at assembly facility.	<ul style="list-style-type: none"> 2 or 3 missiles/year are tested. GLAT is where acceptance occurs. Most test equipment is government owned. Government pays for items destroyed in testing.
HARPOON		Engine tested by manufacturer at its facility. Sustainer section is tested by NMAC/ but only for electric circuitry.	Tested during production for dimension and fit tolerance.	Manufactured at NMS, Louisville; loaded at NMS, Yorktown. Samples are periodically tested at Dahlgren. No test at assembly facility.	<ul style="list-style-type: none"> Approximately 20 missiles/year fired in training. 1 missile/month is given a full AUR test; less firing of motor & warhead. Takes 120 hours to complete test. Lot testing is not called GLAT on this program. Government owns test equipment in contractor plants.
SIDEWINDER		N/A	Contractor performs in-process quality control. Checks dimensions and fit. Packs for shipping with missile	In-process quality control, measurement, etc., by contractor. LAT conducted by exploding samples from each lot w/NAVPRO on hand for acceptance. No test at assembly facility.	<ul style="list-style-type: none"> AUR test is conducted on the aircraft using built in test equipment. Items destroyed in testing are paid for by government. Government owns all test equipment.
SPARROW		N/A	Contractor quality control & inspection. Measures for correct size.	1-3 warheads/lot shipped to NMSC Dahlgren for explosive test. No test at assembly facility.	<ul style="list-style-type: none"> An AUR test is conducted on 10% of the missiles. 95% of each lot must be accepted, for the lot to be accepted. Test takes 1 hour. Test firing of live missiles is done through Fleet training. Government owns all test equipment. G&C test equipment is not the same as the AUR test equipment. 15 missiles/lot are sent to NMIC for data gathering tests. These tests are not part of the acceptance testing program.
SHRIKE		N/A	Contractor quality control & measurement tests. Operation is tested in the post-assembly final test before packing in shipping containers.	Warhead components tested by respective manufacturers. Completed (empty) warheads to Crane for loading; then to Yorktown. No test at Yorktown. Apparently no explosive test of warhead.	<ul style="list-style-type: none"> No AUR test. Post-assembly test is only for a check of the tgd and wings and fins. There is a pre-assembly test of the tgd conducted at Yorktown. Most test equipment is government owned. However, it does have some unique test equipment that they own.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-AC96728	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Missile Acquisition Study		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER LMI Task NA801✓
7. AUTHOR(s) Robert S. Young, Thomas M. O'Hern, Jr.		8. CONTRACT OR GRANT NUMBER(s) MDA903-77-C-0370✓
9. PERFORMING ORGANIZATION NAME AND ADDRESS Logistics Management Institute 4701 Sangamore Road Washington, D. C. 20016		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Air Systems Command NAVAIR 5101 Washington, D. C.		12. REPORT DATE August 1979
		13. NUMBER OF PAGES 71
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) "A" Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Missile Acquisition, Air-Launched Missiles, Decision Tree, Missiles, Government-Furnished Equipment, Contractor-Furnished Equipment, Program Management, Missile Assembly		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This study was commissioned by the Naval Air Systems Command (NAVAIR) to (1) assess the feasibility and desirability of acquiring air-launched missiles from contractors in a ready-for-use configuration (known as the All-Up-Round (AUR) configuration) and (2) construct a Government-furnished equipment versus Contractor-furnished equipment (GFE/CFE) decision tree to assist acquisition personnel in making sound business judgments regarding the use of GFE and CFE in individual missile acquisition programs. Regardless of the procurement (over)		

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method, a contractor may be responsible for the integration of GFE.

The conclusion is that contractor assembly of missiles is feasible because (1) a significant number of prime contractors possess the necessary technical qualifications; (2) such contractors either possess, or have access to, suitable facilities; (3) making contractors responsible for missile integration will neither significantly lessen the capability of naval weapons stations to provide intermediate-level maintenance for the fleet's inventory of air-launched missiles; and (4) will not result in displacement of Federal employees.

Contractor assembly of missiles is also desirable for the following reasons: (1) it is consistent with national policy as expressed in OMB Circular A-76 and DoD's implementing instructions; (2) it would assign system responsibility to a single contractor, thus avoiding the fragmentation of organizational responsibilities which occurs when weapons stations assemble missiles; (3) it could result in a cost savings; (4) it would avoid having a large Government investment tied up in assets which are unusable due to missile components; and, (5) it would alleviate the problems associated with NAVAIR's current personnel shortage and enable acquisition personnel (now engaged in attempting to manage numerous small parts of missile programs) to manage their programs more effectively.

It is recommended that NAVAIR acquire air-launched missiles from prime contractors in the AUR configuration.

A GFE/CFE decision tree is presented and is composed of three segments, one for each type of decision faced by a project manager: (1) those made in the initial acquisition of a system (i.e., the components have never been purchased before); (2) GFE to CFE conversions (break-in); or (3) CFE to GFE conversions (break-out). Guidelines for its use are also provided.

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